
# UPOV REPORT ON THE IMPACT OF PLANT VARIETY PROTECTION

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# SECTION I: INTRODUCTION

Many countries, including developing countries and countries in transition to a market economy, are considering the introduction of a system for the protection of new varieties of plants (PVP system). Most countries which have already introduced a PVP system have chosen to base their system on the International Convention for the Protection of New Varieties of Plants (UPOV Convention) in order to provide an effective, internationally recognized system.

The International Union for the Protection of New Varieties of Plants (UPOV) decided to undertake a study (Impact Study) as means of providing countries considering the introduction of a PVP system with information on the impact of the introduction of PVP systems according to the UPOV Convention. This report is based on the work of a UPOV *Ad hoc* Working Group to Study the Impact of Plant Variety Protection, which included members from all the countries forming the basis of the Impact Study (see Section III).

In order to provide a meaningful study on the impact of PVP it is important to understand the purpose of such intellectual property rights and, equally important, aspects which are not appropriate to be included within the realms of such a system. With respect to the purpose of a PVP system, UPOV clarifies that its mission is "To provide and promote an effective system of plant variety protection, with the aim of encouraging the development of new varieties of plants, for the benefit of society".

Thus, the UPOV system of PVP is designed to encourage innovation in the field of plant breeding. In that respect, the 1991 Act of the UPOV Convention recognizes that it is important to encourage breeding in all plant genera and species and not to pre-determine for which genera and species breeding would, or could, be beneficial. An important corollary to this principle is that it is inappropriate to conclude that a PVP system is not effective because it does not encourage breeding in a particular crop.

In an effective system of PVP the development of new varieties of plants will be encouraged where there is commercial viability, but in cases where there is no existing, or potential, commercial market for varieties, the presence of a PVP system should not be expected to encourage the development of new varieties. Reference to a "potential" commercial market is a recognition of the fact that an effective PVP system can lead to the creation and/or increased availability of new varieties which allow a market demand to be met, which it was not possible for farmers or growers to satisfy without new varieties.

Where there is no commercial market for a particular crop, but where plant breeding is still considered to be necessary, breeding may be supported by the public sector. Such a situation in a particular crop should, however, be seen alongside the overall benefits of the PVP system in relation to the availability of improved varieties for farmers and growers in commercially viable crops. Such benefits of the PVP system can be the key to overall economic development and, in particular, the development of the rural economy in a way which helps farmers to break out of the cycle of subsistence farming.

With regard to matters which do not fall within the realm of an effective PVP system, it is important to note that it is not the role of a PVP system to regulate the marketplace. Thus, the 1991 Act of the UPOV Convention, Article 18, states that "The breeder's right shall be independent of any measure taken by a Contracting Party to regulate within its territory the

production, certification and marketing of material of varieties or the importing or exporting of such material. In any case, such measures shall not affect the application of the provisions of this Convention", thereby clarifying that an effective system is one which is independent of such market regulation. For that reason, it was considered essential that any study on the impact of PVP systems should not be inter-twined with consideration of systems regulating production, certification and marketing. It is further noted that the success of PVP does not depend on the existence of systems regulating production, certification and marketing, as illustrated by the success of PVP in sectors which are not regulated by systems such as national listing and seed certification.

This clarification should not be taken to mean that UPOV believes that there should be a particular type or level of market regulation, but rather as a recognition that such regulation should be dealt with by an appropriate, dedicated and independent mechanism. It is also relevant to note that, for members of UPOV, being part of an internationally harmonized system, the introduction of a PVP system can be established without a large infrastructure, thereby facilitating the introduction of PVP for countries with limited resources (see Section II "Development of the UPOV System of Plant Variety Protection").

In relation to the impact which might be expected from an effective PVP system, it is considered important to recognize that the positive effects of a PVP system may be realized in the form of an incentive to stimulate new breeders and new breeding work and/or providing a basis for more effective breeding work at the domestic level. These positive effects could relate equally to the private breeding sector, the public breeding sector or to partnerships between the two. However, whilst recognizing that such an impact is of critical importance, it is also recognized that an effective PVP system can also provide important benefits, in an international context, by removing barriers to trade in varieties, thereby increasing domestic and international market scope. In short, breeders are unlikely to release valuable varieties into a country without adequate protection. With access to such valuable foreign-bred varieties, domestic growers and producers have more scope to improve their production and also have more scope to export their products. It is also recalled that, as a consequence of the breeder's exemption in the UPOV Convention, domestic breeders also gain access to valuable varieties for use in their breeding programs. This international aspect is an important means of technology transfer and effective utilization of genetic resources.

The UPOV mission statement refers to "the aim of encouraging the development of new varieties of plants, for the benefit of society". Clearly, it is not possible to detail all the benefits, or even the range of benefits, to society of the introduction of new varieties of plants, because the scope is enormous. However, the range includes: economic benefits, for example through varieties with improved yield leading to reductions in the price of end-products for consumers, or improved quality, leading to higher value products with increased marketability; health benefits, for example through varieties with improved nutritional content; environmental benefits, for example through varieties with improved disease resistance or stress tolerance; and even pure pleasure, for example with ornamental plants. Society in this context means all society, and all members of society are consumers in some way. However, it is also recognized that farmers and growers are the deliverers of the benefits of new varieties to society and are also the first beneficiaries of new varieties which offer improved income through improved yields, improved quality and the opening-up of new market possibilities.

In recognition of the factors set out above, the study comprises two main parts. Firstly, reflecting the fact that the effectiveness of a PVP system owes much to international recognition and harmonization, Section II reviews the development of the UPOV system at

the international level. Section III reviews the impact of the introduction of a plant variety protection system in selected UPOV members (Argentina, China, Kenya, Poland and the Republic of Korea). Conclusions are drawn in Section IV.

# SECTION II: DEVELOPMENT OF THE UPOV SYSTEM OF PLANT VARIETY PROTECTION

## UPOV Membership

The UPOV Convention was adopted in 1961 as a result of the Diplomatic Conferences held in Paris in 1957 and 1961. The UPOV Convention entered into force in 1968 with the membership of Germany, the Netherlands and the United Kingdom. The UPOV Convention was amended in 1972, 1978 and 1991. As of September 15, 2005, UPOV had 60 members of which 33 are bound to the 1991 Act of the Convention (see Annex I). UPOV, which continues to be the only internationally harmonized, effective *sui generis* system of plant variety protection, is continuing to expand. 18 States (initiating States) and one international organization (initiating organizations) have initiated with the Council of UPOV the procedure for becoming members of the Union (see Annex II) and another 47 States have been in contact with the Office of the Union for assistance in the development of legislation on plant variety protection.

Figures 1 and 2 illustrate how UPOV has expanded since 1990 to cover the most important agricultural producers and many countries from the developing world.

*Figure 1: Members of UPOV (shown in green): 1990*

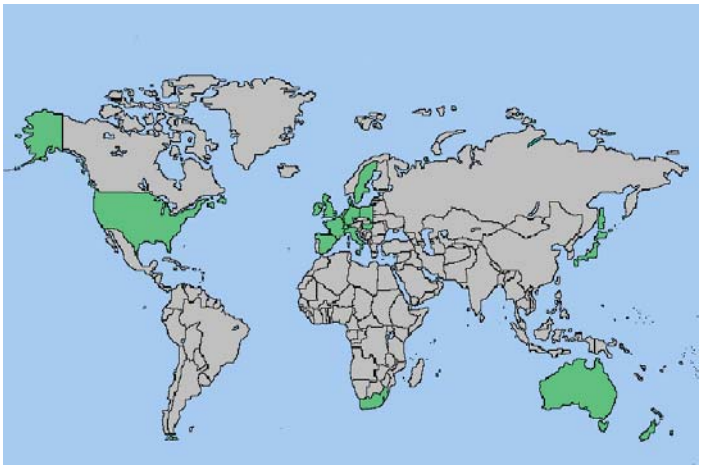
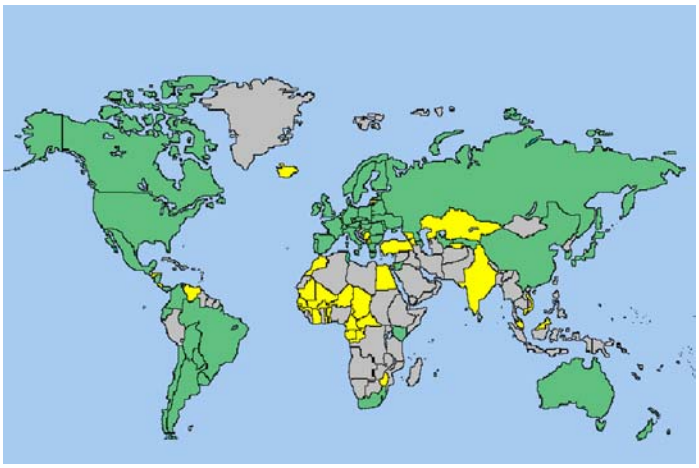


*Figure 2: Members of UPOV (shown in green) and initiating States and organizations (shown in yellow): September, 2005*



As explained in Section I (Introduction), the key to an effective PVP system is to provide incentives to breeders to develop new varieties and to avoid the absence of suitable protection being a barrier to the availability of those varieties. With regard to assessing the overall impact of an effective PVP system from a global viewpoint, it is, therefore, reasonable to look at the number of new varieties. A direct measure of the number of new varieties is provided by the number of applications for protection and the number of titles of protection granted to new varieties of plants (titles). The number of applications and titles are meaningful measures of the impact of PVP, since they indicate new varieties which have potential importance within the territory concerned. It is recognized that, in a market economy, the value of a variety is ultimately determined by whether it is commercially successful. Therefore, the fact that, in general, breeders do not pursue protection on varieties which are unlikely to be successful or where protection is not important, would seem to offer further confirmation that the number of applications and titles are good indicators of the benefits of a PVP system.

Thus, an illustration of the overall impact of the UPOV system is provided by the number of titles of protection in force within the UPOV system. Figure 3 shows the number of titles in force with members of the Union and the Community Plant Variety Office (CPVO) for the period 1968 to 2003 and Figure 3 bis shows the number of applications for the same period. The CPVO is a European Community agency which manages a system of plant variety rights covering the member States of the European Community. The CPVO data have been included since their introduction in 1995 because, whilst the European Community only became a member of UPOV in 2005, most of the member States were members of UPOV in 1995. It can be seen in Figure 4 that a significant adjustment in the number of applications took place as a result of the introduction of the CPVO in 1995 (see section on "*European Community Countries*").

*Figure 3*

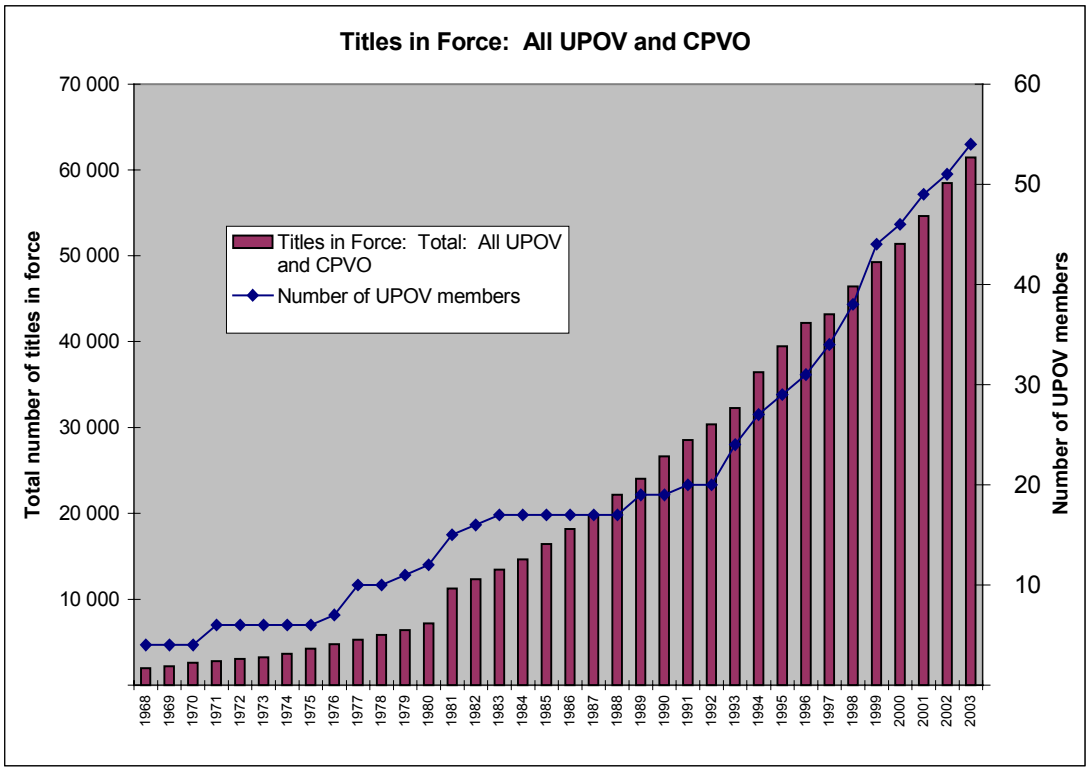
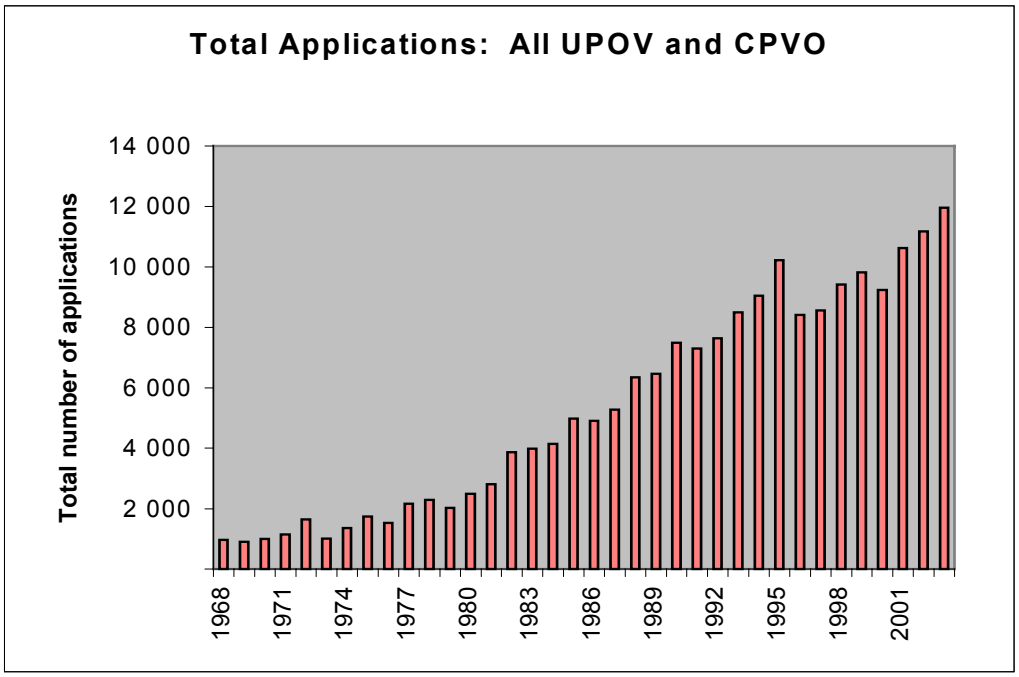
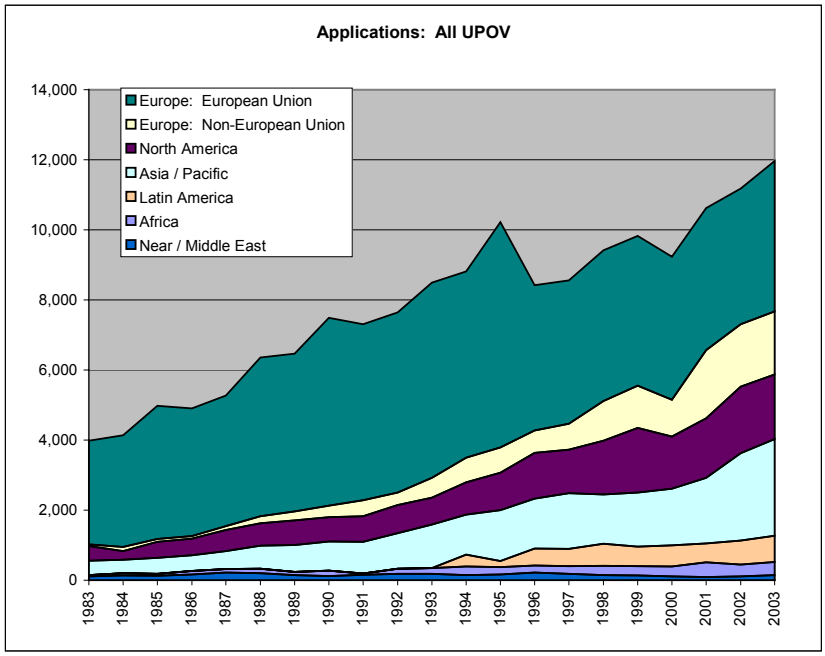


*Figure 4*




With the expansion of UPOV, the importance of PVP has grown in different regions, as illustrated in Figure 5. The growth in the UPOV membership of countries from Asia, Latin America and countries in transition to a market economy between 1983 and 2003 is reflected in their growing use of the PVP system.

*Figure 5*



Expanding the protection across plant genera and species

In addition to the geographical expansion of UPOV, Article 3 of the 1991 Act of the UPOV Convention, made provision for protection to be offered to all plant genera and species, which has extended the coverage of the UPOV system and contributed to the growth in the number of titles granted. Even before the 1991 Act of the UPOV Convention came into force in 1998, members of the Union had responded to demands for protection for an ever-increasing number of genera and species. In 1975, protection had been granted to varieties of approximately 500 plant genera or species, growing to around 900 by 1985 and over 1,300 by 1995. It is estimated that protection had been granted to varieties of around 2,000 genera or species by 2005.

Implementation of Plant Variety Protection

Clearly, it is important that an effective PVP system not only provides a legal basis for protection, but also has the necessary mechanisms to enable its implementation in a practical and efficient manner. UPOV offers such a basis by providing guidance and by making provision for cooperation and support, particularly with regard to the examination of Distinctness, Uniformity and Stability ("DUS testing"), thereby removing potential practical constraints on the development of a PVP system.

At the administrative level, UPOV provides guidance to legislators and authorities implementing PVP. At the technical level, an important role is the development of guidance for DUS testing, in particular in the form of guidelines for specific plant genera and species (Test Guidelines). By 2005, UPOV had developed over 220 Test Guidelines. Typically, UPOV is working on around 50 to 60 Test Guidelines each year, both revisions to existing Test Guidelines and the development of Test Guidelines for new genera and species. Although PVP systems and other systems such as those regulating commerce are independent, it is well recognized that the work of UPOV in the area of DUS testing underpins certain other systems and UPOV encourages coordination of activities, such as in DUS testing, where this is necessary for other systems and where this offers operational efficiencies.

Cooperation with regard to DUS testing is an important benefit of the UPOV system. The UPOV Convention (Article 12 of the 1991 Act) requires that a variety be examined for compliance with the distinctness, uniformity and stability criteria. The 1991 Act then clarifies that, "In the course of the examination, the authority may grow the variety or carry out other necessary tests, cause the growing of the variety or the carrying out of other necessary tests, or take into account the results of growing tests or other trials which have already been carried out". That wording indicates that an authority may, for example, use one or more of the following arrangements:

*(a) the authority conducts growing trials, or other tests, itself*

*(b) the authority arranges for another party / other parties to conduct the growing trials or other tests*

In such an arrangement, another party could include, for example, another member of the Union, an independent institute, or the breeder. This provision allows members of the Union to avoid the need to establish a DUS testing infrastructure. In the case of cooperation with another member of the Union, such

arrangements allow, for example, PVP authorities to avoid the duplication of DUS testing work.

*(c) the authority takes into account the results of growing tests or other trials which have already been carried out*

This possibility allows for members of the Union to accept DUS reports on varieties already examined by another member of the Union.

Cooperation has always been a key benefit of membership of UPOV and, as UPOV has grown both geographically and in terms of the number of plant genera and species for which protection has been required, that aspect has become more important, but also more powerful. Cooperation and harmonization can be advanced further by regional approaches, such as that developed in the European Community.

Expansion of UPOV: A benefit for new and old members of the Union

The following section observes the way in which the expansion of UPOV benefits older and newer UPOV members. To look at the situation from the perspective of oldest and newest members, the section categorizes countries into those which were UPOV members by 1992 (older members) and those which became members at a later time (newer members). The year of 1992 was chosen because, as can be seen in Figure 3, that year signified the end of a period of fairly stable membership and the start of a continuous expansion in membership.

*Older UPOV Members: the European Community Countries*

The introduction of the CPVO system in 1995 had a significant impact on the situation in the European Community.

The scale of the impact of the CPVO within the European Community is demonstrated in Figure 6, which shows that the number of applications for protection with the CPVO has continued to increase, whilst the total number of applications within the European Community has been reduced as a result of a single CPVO title covering the whole territory of the European Community. Based on trends before and after the introduction of the CPVO, the trend line in Figure 7 assumes that, on average, a CPVO title replaces 2.5 national titles. On the basis of that hypothesis, it is possible to extrapolate that, as a result of the introduction of the CPVO system, where one CPVO protection covers all members of the European Community, breeders have been able to reduce the number of applications required for equivalent, or wider, protection within the European Community from around 8,000 to just over 4,000 in 2003.

*Figure 6*

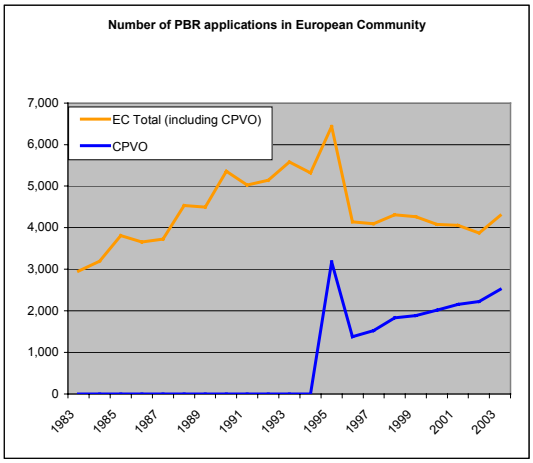
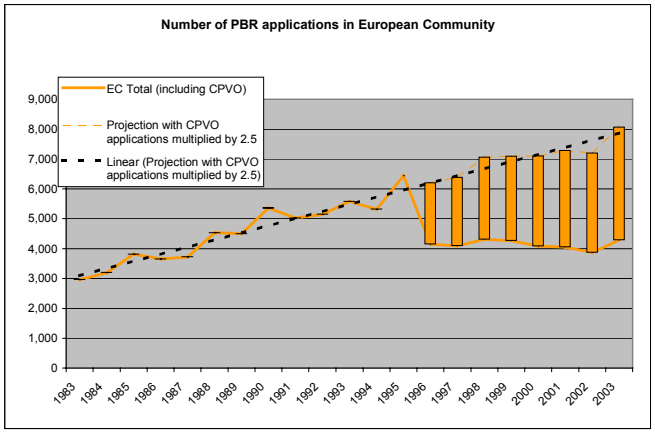



*Figure 7*




It has been noted by some observers that the development of such a regional system has particular benefits for breeders from countries located outside the region concerned. These observations are based on the fact that there is less requirement for the breeder to assess the need for protection in each of the individual countries and the fact that the administrative procedures are greatly simplified compared to a situation where applications have to be made in many countries and languages. The graph in Figure 8 demonstrates that the number of applications with the CPVO has continued to rise for both resident breeders and non-resident breeders, but also demonstrates that the number of applications from non-resident breeders has risen faster, from 12% of applications in 1996 to 23% in 2003.

*Figure 8*

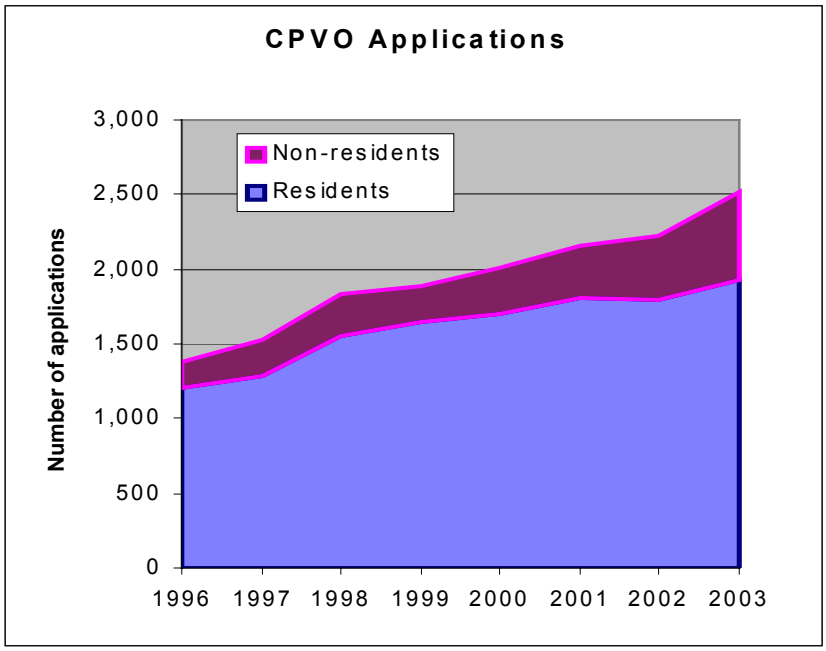
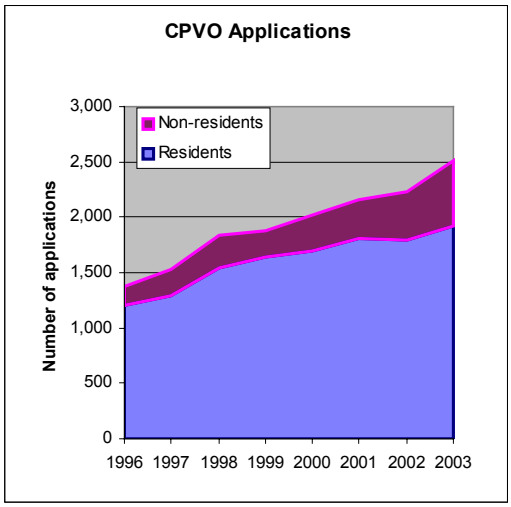



Figure 8 demonstrates how the European Community has offered an increasingly important market for breeders from outside the European Community. On the other hand,

Figure 9, which analyzes the number of applications made by residents of 10 European Community countries (Belgium, Denmark, France, Germany, Ireland, Italy, Netherlands, Spain, Sweden and United Kingdom: those which were members of the Union by 1992) with members of the Union other than those belonging to the European Community countries, demonstrates that the expansion of UPOV has presented increased opportunities for breeders based in the European Community.

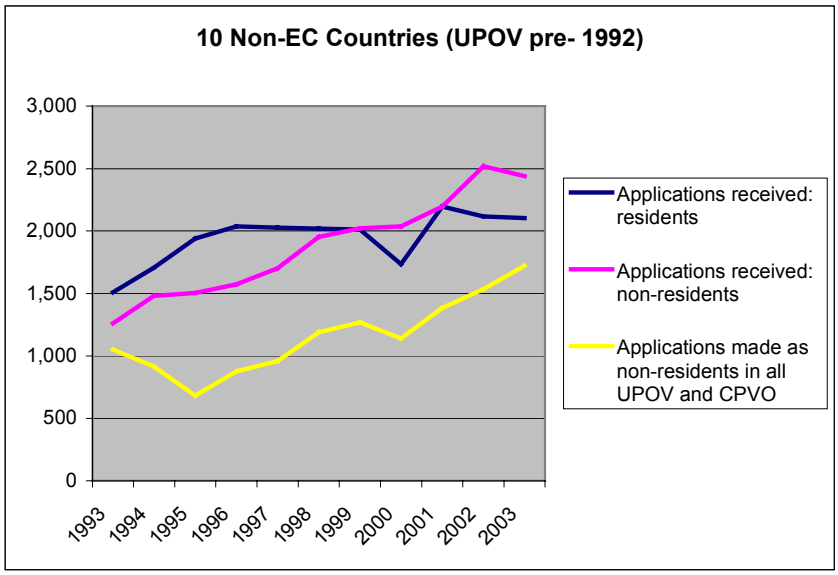
*Figure 9*




*Older UPOV Members: Other Countries*

An overview of developments with regard to the other 10 older members of the Union (Australia, Canada, Hungary, Israel, Japan, New Zealand, Poland, South Africa, Switzerland, United States of America) which were members of the Union by 1992, is provided in Figure 10. In a similar way to developments for the European Community, that group of countries has also seen an increase in the number of applications received, particularly from non-residents and also shows that the number of applications made by their breeders in other territories has also increased. The reduction in the number of foreign applications in 1994 and 1995 resulted from the introduction of the CPVO (see above).

*Figure 10*



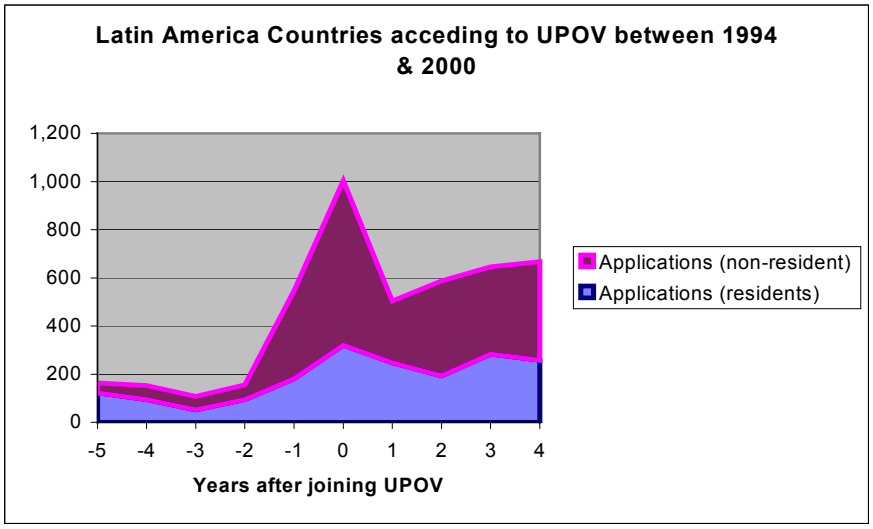
The developments in the 20 older (pre-1992) UPOV members, as summarized in Figures 6 to 10, show the importance of an international PVP system. Put simply, farmers, growers and breeders have had access to the best varieties produced by breeders throughout UPOV members and have been shown to be taking full and increasing advantage of that opportunity.

*Newer UPOV Members*

With regard to countries which have joined UPOV more recently, it is already possible to consider impacts which became apparent immediately on joining UPOV, or soon thereafter. The majority of countries which joined UPOV between 1993 and 2000 and, therefore, for which it has been possible to obtain useful data, were countries in transition to a market economy (Bulgaria, Czech Republic Estonia, Kyrgyzstan, Republic of Moldova, Russian Federation, Slovakia, Slovenia and Ukraine) or were Latin American countries (Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Mexico, Panama, Paraguay and Uruguay). An overview of developments in those two categories is provided below. Of the remaining seven countries which joined UPOV between 1993 and 2000 (Austria, China, Finland, Norway, Portugal, Trinidad and Tobago and Kenya), China and Kenya are the subject of individual country profiles in this Study.

An overview summary of the 10 Latin American countries which joined UPOV between 1993 and 2000 is provided in Figure 11. It is apparent that joining UPOV was characterized by a substantial demand for variety protection and, in particular, a large influx of foreign varieties (applications by non-residents). A high proportion of non-resident applications appear to relate to ornamental varieties. In that regard, it can be observed that access to such varieties is important to enable producers in those countries to meet the demands of the global market place and indicates how the lack of an effective and internationally recognized PVP system can act as a barrier to global trade.

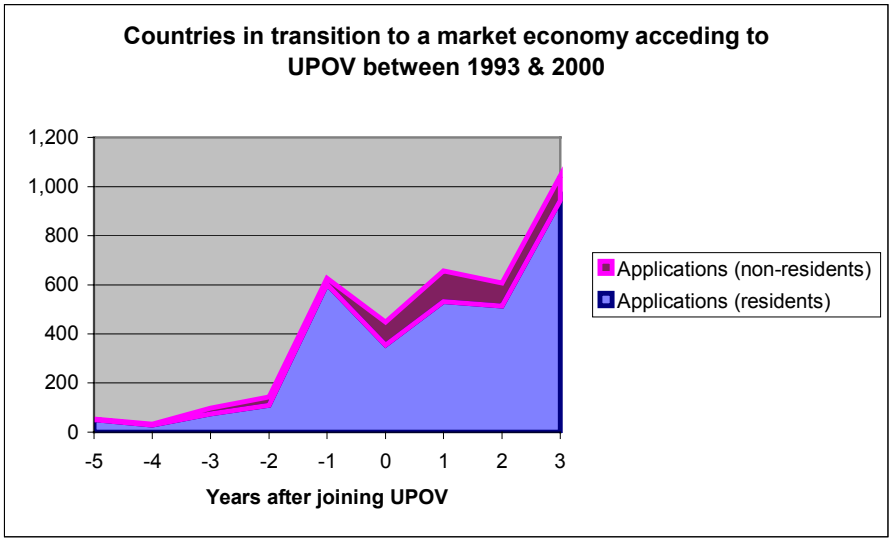
*Figure 11*




An overview summary of the eight countries in transition to a market economy which joined UPOV between 1993 and 2000 is provided in Figure 12. It is apparent that joining

UPOV was accompanied by a substantial demand for variety protection, with the majority of applications made by domestic breeders.

*Figure 12*




The results demonstrate that joining UPOV was accompanied by a strong demand for protection of new varieties of plants, both in Latin American countries and countries in transition to a market economy. The nature of the demand varied between the two sets of countries, with a particularly high demand for ornamental varieties from non-resident breeders in Latin America, in contrast to a higher demand from resident breeders in countries in transition to a market economy. This picture highlights the fact that the impact of an effective PVP system will be to respond to the circumstances in the territory concerned and to provide benefits where these can be obtained. The following individual country reports illustrate further the different ways in which the benefits may be manifested.

# SECTION III: REPORTS ON STUDIES CONDUCTED IN INDIVIDUAL COUNTRIES

Country studies have been conducted by the respective national plant variety protection offices of Argentina, China, Kenya, Poland and the Republic of Korea. Profiles of these countries are summarized in Annex III and a brief summary of their plant variety protection systems is given in Annex IV.

The study seeks to assess the impact of plant variety protection by considering the situation before and after the introduction of a PVP system and/or its adaptation to the provisions of the UPOV Convention and UPOV membership. Plant variety protection statistics (number of applications for protection and number of titles of protection) were an important common source of information for the preparation of country reports. In other respects, the different situations in the study countries and in different crops meant that there was variation in the type of available information e.g. with respect to national listing and seed certification.

Data were supplemented with illustrative information collected, where possible, through interviews with breeders, seed companies and national seed associations. This supplementary information is usually presented in "boxes" within the country reports.

With respect to plant variety protection statistics, the main source of information was UPOV/World Intellectual Property Organization (WIPO) statistics. Certain terms are used in those statistics. In particular, "residents" means nationals of the country in question, as well as natural persons resident, and legal entities having their registered offices, within the territory of the country in question and "non-residents" means all other natural persons and legal entities. For the purposes of this study and report, the terms "resident breeder" and "non-resident breeder" are interchanged with "domestic breeder" and "foreign breeder". The protection offered by the UPOV system is in the form of a "title" of protection, "granted" to the breeder, for the variety concerned. With respect to the UPOV system, that title is sometimes referred to as a plant breeder's right (PBR).

As explained in Sections I and II, the key to an effective PVP system is to provide incentives to breeders to develop new varieties and to avoid the absence of suitable protection being a barrier to the availability of those varieties. With regard to assessing the overall impact of an effective PVP system, it is, therefore, reasonable to look at the number of new varieties. A direct measure of the number of new varieties is provided by the number of applications for protection and the number of titles of protection granted to new varieties of plants (titles). The number of applications and titles are meaningful measures of the impact of PVP, since they indicate new varieties which have potential importance within the territory concerned. It is recognized that, in a market economy, the value of a variety is ultimately determined by whether it is commercially successful. Therefore, the fact that, in general, breeders do not pursue protection on varieties which are unlikely to be successful or where protection is not important, would seem to offer further confirmation that the number of applications and titles are good indicators of the benefits of a PVP system.

In addition to using the number of applications and numbers of titles from both residents and non-residents as an indication of the number of new varieties in a territory, the number of applications and titles for residents is used in the country reports as an indication of the level of breeding at the domestic level.

When measuring the immediate impact of the introduction of a PVP system, the use of titles of protection is not always the most direct indicator, because the time from application to the granting of a title can vary according to the arrangements for DUS testing and the type of variety. For example, the duration of the DUS examination may be one, two, or even three years in the same country, according to the type of variety being examined. That means that the time from application to granting of a title may vary from one to perhaps four years, thereby obscuring the immediate use that breeders may have made of the system in the form of immediate applications. For that reason, the number of applications is used as an important indicator in this Impact Study. However, in some situations, such as in Argentina, the use of a breeder-based DUS testing system can mean that the time from application to granting of a title is short (a few months) and less dependent on the type of variety and, in such cases, the number of titles granted can provide a direct and immediate indicator of the impact of the introduction of PVP.

# ARGENTINA

## *1. General View of Agriculture in the Country*

Argentina is divided into four topographical regions: (1) the Pampas, which occupies one quarter of the country, rises gradually from the Atlantic Ocean to the Andean foothills; (2) Patagonia which is a windswept semi-arid region in the south; (3) the northeastern lowlands which lie to the north of the Pampas and east of the Andes; and (4) the northwestern Andes which extend along the western half of the country.

The climate varies from a humid sub-tropical climate in the north, to the central semi-arid Pampa, ranging from a tropical to a moderately cool climate. The southern area of the country is sub-arctic. Rainfall diminishes from east to west, with snow falling rarely.

The Pampas are intensively exploited for the cultivation of maize, sorghum, soybean, sunflower and wheat for exportation, and for livestock production. Fruit crops (in particular citrus fruits), peanuts and vegetables are also produced.

The principle products for the other areas (extra-pampas) include perennial crops such as apple, grape, pear, tea, and yerba mate (*Ilex paraguariensis* A. St.-Hil.) as well as industrial crops such as cotton, sugarcane and tobacco. Argentina is a large exporter of beef, maize, soybean products, sunflower oil and wheat.

As indicated in Table 1 below, "farms" with more than 1,000 hectares (7.6% of all farms) occupy 75% of the total agricultural area, while those with less than 25 hectares (35% of all farms) occupy only 1% of the land.

Table 1: Argentina: Number of farms and area

| Surface | Number of farms | % | Area (1,000 ha) | % |
|---|---|---|---|---|
| Up to 5 ha | 51,697 | 14.2 | 133 | 0.07 |
| 5 - 25 ha | 78,478 | 21.6 | 1,114 | 0.6 |
| 25 - 100 ha | 90,392 | 25.0 | 5,227 | 3.0 |
| 100 - 200 ha | 46,391 | 12.8 | 6,831 | 3.9 |
| 200 – 1,000 ha | 68,166 | 18.8 | 29,856 | 17.0 |
| 1,000 – 5,000 ha | 21,012 | 5.9 | 45,192 | 25.8 |
| 5,000 – 10,000 ha | 3,306 | 0.9 | 24,278 | 13.8 |
| 10,000 ha | 2,829 | 0.8 | 62,891 | 35.8 |
| Total | 362,271 | 100 | 175,523 | 100 |

## *2. Short Description of the Seed Industry*

For major crops, such as barley, maize, rye, sorghum and wheat, variety improvement started toward the end of the nineteenth century.

Systematic and scientific breeding started in Argentina in 1956 when the National Institute of Agricultural Technology (INTA) was established. INTA works on a large number of crops including barley, cotton, lucerne, oats, sunflower, wheat and fruit crops. Until 1973, when Law N° 20.247/73 on Seed and Phytogenetic Creations was enacted, plant breeding had been conducted mainly by the public sector. This Law contained provisions for plant variety protection (PVP).

During the 1980s, foreign companies and foreign varieties became part of the seed business in Argentina, in many cases through the acquisition of national seed companies. In the 1990's, the introduction of genetically modified varieties further stimulated private sector activities in the seed industry.

*3. Plant Variety Protection System*

Law N° 20.247/73 on Seed and Phytogenetic Creations of March 30, 1973, provides a system of plant variety protection by the granting and protecting of plant breeders' rights. The first varieties were protected in 1981. Regulations to the Law were made by means of regulatory decrees. Since 1991, Regulatory Decree N° 2183/91 to Law N° 20.247/73 on Seed and Phytogenetic Creations has been the legislation in force. In 1994, Law N° 24.376/94 was passed by the National Congress, as a result of which the provisions of the 1978 Act of the UPOV Convention became integrated into national laws. The main provisions of the different legal instruments are summarized in Box 1 below:

Box 1: The main provisions of the different legal instruments

| |
|---|
| Law N° 20.247/73 on Seed and Phytogenetic Creations:<br><br>• Recognized property rights on plant varieties;<br>• Established the National Register of Property of Varieties;<br>• Specified the duration of protection;<br>• Established an examination for PVP;<br>• Established the reasons for expiration of protection;<br>• Defined "seed" and "phytogenetic development";<br>• Established a National Seeds Board (an advisory commission). |
| Regulatory Decree N° 2183/91:<br><br>• incorporates the provisions of the 1978 Act of the UPOV Convention into Law N° 20.247/73 on Seed and Phytogenetic Creations except for certain aspects concerning foreign applications |
| Law N° 24.376/94:<br><br>• incorporates the 1978 Act of the UPOV Convention into national law |

The National Institute of Seeds (Instituto Nacional de Semillas (INASE)) was created in 1991 and is responsible for PVP. Argentina became bound by the 1978 Act of the UPOV Convention on December 25, 1994. Argentina provides protection to varieties of all plant genera and species.

## *4. Impact of Plant Variety Protection*

### (a) Overall Trends of Varieties Available in the Country

#### *(i) Number of Varieties*

In 1991, INASE was created and the PVP system was amended to be in conformity with the 1978 Act of the UPOV Convention, except for certain aspects concerning foreign applications. Figure 13 demonstrates that those developments were accompanied by a substantial increase in the number of titles granted to domestic breeders. In the 10-year period prior to those developments (1982-1991) the average annual number of titles granted to domestic breeders was 26, which more than doubled to 70 (267%) for the subsequent 10-year period (1992-2001). Prior to 1994, Argentina provided protection to varieties bred by non-residents on a mutual reciprocity bases (i.e. where Argentinean breeders were able to protect varieties in those other countries), resulting in bilateral agreements in some cases. In 1994, the PVP system in Argentina became fully compatible with the 1978 Act of the UPOV Convention, including with respect to foreign applications, and Argentina acceded to the UPOV Convention. The number of titles granted to non-residents increased in conjunction with those developments. In the 10-year period prior to those developments (1984-1993) the average annual number of titles granted to non-residents was 17, which more than trebled to 62 (355%) for the subsequent 10-year period (1994-2003). Figure 14 shows a steady increase in the number of PVP titles in force.

Figure 13: Argentina: Number of Titles Granted

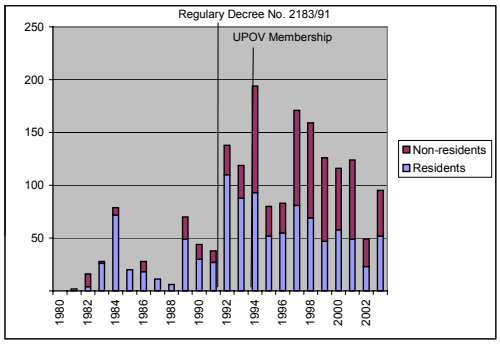



Figure 14: Argentina: Number of Titles in Force

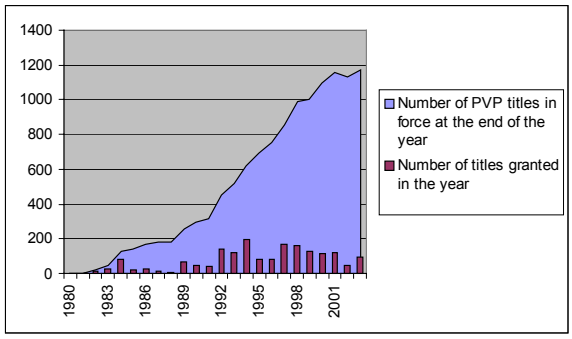


Table 2 shows that a considerable number of varieties of agricultural crops such as soybean, maize, lucerne and wheat have been developed for Argentine farmers through the PVP system.

Table 2: Argentina: Number of titles granted in each year from 1992 to 2004 (top 10 crops)

| | 1992 | | 1993 | | 1994 | | 1995 | | 1996 | |
|---|---|---|---|---|---|---|---|---|---|---|
| Order | Crops | No | Crops | No | Crops | No | Crops | No | Crops | No |
| 1 | Maize | 53 | Maize | 25 | Soybean | 24 | Maize | 12 | Maize | 23 |
| 2 | Soybean | 18 | Sunflower | 18 | Lucerne | 16 | Soybean | 10 | Soybean | 15 |
| 3 | Oilseed rape | 12 | Sorghum | 17 | Maize | 11 | Lucerne | 9 | Lucerne | 7 |
| 4 | Lucerne | 7 | Lucerne | 15 | Beans | 8 | Sunflower | 9 | Wheat | 7 |
| 5 | Strawberry | 5 | Soybean | 14 | Strawberry | 7 | Strawberry | 5 | Cotton | 5 |
| 6 | Wheat | 5 | Wheat | 6 | Tomato | 6 | Artichoke | 4 | Peach | 5 |
| 7 | Triticale | 5 | Cotton | 4 | Wheat | 6 | Barley | 4 | Sunflower | 5 |
| 8 | Squash | 3 | Barley | 3 | Rice | 3 | Beans | 4 | Rice | 3 |
| 9 | Lettuce | 3 | Tomato | 3 | Rye | 3 | Wheat | 4 | Pumpkin | 3 |
| 10 | Onion | 2 | Oilseed rape | 2 | Potato | 3 | Oilseed rape | 3 | Tall fescue | 2 |
| Total of the 10 | | 113 | | 107 | | 87 | | 64 | | 75 |
| Total titles granted | | 138 | | 119 | | 194 | | 80 | | 83 |

Table 2: Cont.

| | 1997 | | 1998 | | 1999 | | 2000 | | 2001 | |
|---|---|---|---|---|---|---|---|---|---|---|
| Order | Crops | No | Crops | No | Crops | No | Crops | No | Crops | No |
| 1 | Lucerne | 38 | Soybean | 33 | Soybean | 40 | Soybean | 30 | Maize | 38 |
| 2 | Soybean | 36 | Rose | 25 | Maize | 26 | Maize | 11 | Soybean | 36 |
| 3 | Maize | 26 | Wheat | 15 | Lucerne | 11 | Lucerne | 10 | Wheat | 13 |
| 4 | Wheat | 10 | Lucerne | 13 | Rose | 9 | Wheat | 10 | Lucerne | 8 |
| 5 | Rose | 7 | Maize | 10 | Wheat | 9 | Sunflower | 8 | Cotton | 5 |
| 6 | Strawberry | 5 | Perennial ryegrass | 7 | Cotton | 4 | Bromus | 6 | Rose | 4 |
| 7 | Perennial ryegrass | 5 | Apple tree | 6 | Japanese Plum | 4 | Cotton | 4 | Sorghum | 4 |
| 8 | Rice | 4 | Oats | 5 | Rye grass | 4 | Apple | 4 | Pea | 3 |
| 9 | Peas | 4 | Oilseed rape | 4 | Rice | 2 | Cocksfoot | 4 | Bromus | 3 |
| 10 | Onion | 3 | Italian ryegrass | 4 | Bromus | 2 | Rose | 4 | Ryegrass | 3 |
| Total of the 10 | | 138 | | 122 | | 111 | | 91 | | 117 |
| Total titles granted | | 171 | | 159 | | 126 | | 116 | | 124 |

Table 2: Cont.

| | 2002 | | 2003 | | 2004 | |
|---|---|---|---|---|---|---|
| Order | | | Crops | No | Crops | No |
| 1 | Soybean | 15 | Maize | 41 | Soybean | 39 |
| 2 | Wheat | 9 | Soybean | 21 | Lucerne | 13 |
| 3 | Lucerne | 4 | Peanut | 5 | Soft wheat | 12 |
| 4 | Ryegrass | 4 | Sorghum | 5 | Petunia | 7 |
| 5 | Strawberry | 3 | Wheat | 4 | Grapevine | 6 |
| 6 | Potato | 3 | Lucerne | 3 | Kiwifruit | 5 |
| 7 | Cherry (Rootstock) | 2 | Cotton | 3 | Potato | 4 |
| 8 | Alstroemeria | 1 | Blueberry | 3 | Barley | 3 |
| 9 | Rice | 1 | Bromus | 2 | Bromus | 3 |
| 10 | Oats | 1 | Barley | 1 | Strawberry | 3 |
| Total of the 10 | | 43 | | 88 | | 95 |
| Total titles granted | | 49 | | 95 | | 128 |

*(ii) Improvement of Varieties*

The introduction of PVP encouraged breeding activities for various crops, and resulted in the release of improved varieties of various crops including, for example, soybean (see Box 2) and wheat (see Box 3).

| Box 2 | Box 3 |
|---|---|
| Genetically modified soybean varieties with herbicide resistance, developed by both national and foreign breeders, started to obtain protection in 1996. Farmers adopted this technology quickly. Herbicide resistance and higher yields were the most important advantages of this technology.<br><br>The following are examples of genetically modified Glyphosate resistant soybean varieties:<br><br><u>Foreign-bred varieties</u>:<br>- 93B85 (Maturity Group III):<br>bred by the Pioneer Overseas Corporation<br>- ACA 360 GR (Maturity Group III):<br>bred by JG Limited<br>- AW 5581 (Maturity Group V):<br>bred by Monsanto Co.<br><br><u>Argentine-bred varieties:</u><br>- A 4201 RG (Maturity Group IV):<br>bred by Nidera S.A.<br>- ADM 4800 (Maturity Group IV):<br>bred by Asociados Don Mario S.A.<br>- Agustina 49 (Maturity Group IV):<br>bred by RELMO S.A.<br>- Dalia 500 (Maturity Group V):<br>bred by Agroservicios S.A. | The French wheat variety "Baguette Premium 13", bred by Mr. C.C. Benoist and protected in Argentina, shows a potential average yield of 6,059 kg/ha whereas the average yield in Argentina is round 3,000 kg/ha.<br><br>Wheat varieties developed by national breeders have provided improved baking quality. The following varieties, all protected, are classified in the National Quality Group No 1:<br><br>- ACA 302: bred by<br>the Argentine Cooperative Association (ACA)<br>- Buck Arriero; Buck Panadero:<br>bred by Cr. Buck Semillas S.A<br>- Klein Delfin; Klein Proteo:<br>bred by Criadero Klein<br>- Prointa Huenpan; Prointa Molinero: bred by the National Institute of Agricultural Technology (INTA)) |

The impact of PVP on the improvement of varieties may also be seen by the extent to which new, protected varieties gain market share, indicating their value to farmers. In some, mainly agricultural, crops where there is a seed certification scheme, the importance of "new" varieties (for these purposes, "new" varieties are considered to be those varieties released during the previous four years) can be estimated by the proportion of certified seed comprising new varieties in relation to the total certified seed for the crop (measured in area for certified seed production).

As shown in Figure 15, for wheat, there has been a continual increase in demand for certified seed of new, protected varieties (during the period of study (1995 to 2001), all "new" varieties were protected varieties) compared to older varieties, rising from 18% of the total area for certified seed production in 1995 to 82% in 2001. Since certified seed is the only category of wheat seed which can be commercialized in Argentina, this data can be taken as a good indicator of the market demand for new, protected varieties.

The situation found in soybean is similar to that for wheat. As shown in Figure 16, the share of new, protected varieties (during the period of study (1995 to 2001), all "new" varieties were protected varieties) increased from 35% in 1995 to 94% in 2001.

In conclusion, in the case of wheat and soybean, new, protected varieties have substantially increased their share of the market, which can be taken as an effective assessment of the improvement these new varieties offer to farmers.

Figure 15: Argentina: Proportion of certified seed arising from new, protected varieties (wheat)

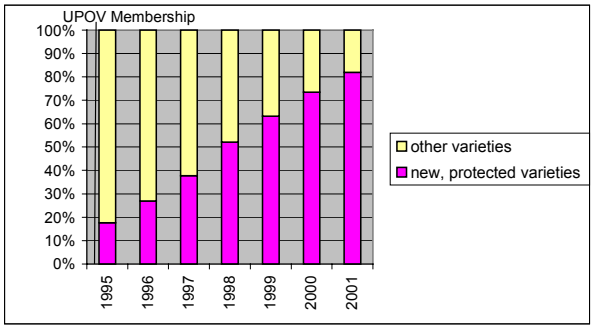
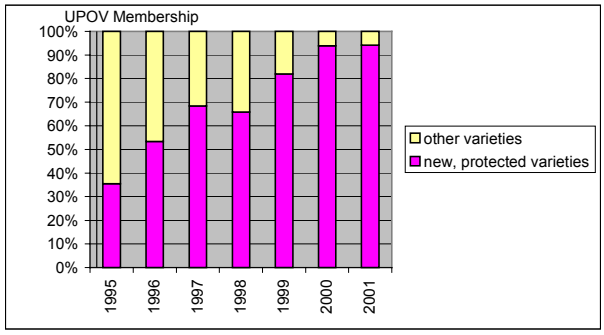



Figure 16: Argentina: Proportion of certified seed arising from new, protected varieties (soybean)




(b) Foreign Investment / International Dimension

*(i) Introduction of Foreign Varieties*

As shown in Table 3, the PVP system has encouraged the introduction of a number of foreign varieties of crop species which are important for Argentine agriculture, such as soybean and lucerne, as well as rose and strawberry, in the horticultural field.

Table 3: Argentina: Number of applications by non-residents by crop (top 10 crops)

| | 1995 | | 1996 | | 1997 | | 1998 | | 1999 | |
|---|---|---|---|---|---|---|---|---|---|---|
| Order | Crop | No | Crop | No | Crop | No | Crop | No | Crop | No |
| 1 | Maize | 14 | Peach | 7 | Soybean | 29 | Rose | 42 | Soybean | 45 |
| 2 | Soybean | 12 | Rose | 7 | Lucerne | 19 | Soybean | 23 | Lucerne | 16 |
| 3 | Lucerne | 10 | Soybean | 5 | Strawberry | 8 | Potato | 14 | Rose | 7 |
| 4 | Potato | 3 | Peas | 4 | Perennial ryegrass | 6 | Lucerne | 13 | Cotton | 4 |
| 5 | Cotton | 2 | Nectarine | 3 | Tall fescue | 5 | Perennial ryegrass | 7 | Wheat | 3 |
| 6 | Strawberry | 2 | Annual ryegrass | 3 | Rose | 4 | Cotton | 3 | Japanese plum | 3 |
| 7 | Perennial ryegrass | 2 | Red clover | 3 | Apple tree | 3 | Peas | 3 | Potato | 3 |
| 8 | Sunflower | 1 | Potato | 2 | Oilseed rape | 3 | Japanese plum | 2 | Aglaonema | 2 |
| 9 | Oilseed rape | 1 | Barley | 2 | Cocksfoot | 2 | Cocksfoot | 2 | Ficus | 2 |
| 10 | Tall fescue | 1 | Oilseed rape | 2 | Oats | 2 | Annual ryegrass | 2 | Strawberry | 2 |

Table 3: Cont.

| | 2000 | | 2001 | | 2002 | | 2003 | | 2004 | |
|---|---|---|---|---|---|---|---|---|---|---|
| Order | Crop | No | Crop | No | Crop | No | Crop | No | Crop | No |
| 1 | Soybean | 25 | Soybean | 30 | Soybean | 26 | Soybean | 8 | Lucerne | 13 |
| 2 | Annual ryegrass | 7 | Wheat | 10 | Peach | 9 | Blueberry | 4 | Soybean | 11 |
| 3 | Perennial ryegrass | 6 | Lucerne | 7 | Tangerine | 7 | Tangerine | 4 | Petunia | 7 |
| 4 | Potato | 6 | Nectarine | 5 | Interspecific rootstock | 4 | Lucerne | 3 | Grape wine | 6 |
| 5 | Strawberry | 4 | Potato | 5 | Wheat | 3 | Apple tree | 3 | Wheat | 5 |
| 6 | Hybrid ryegrass | 2 | Blueberry | 3 | Lucerne | 2 | Beans | 2 | Kiwifruit | 5 |
| 7 | Lucerne | 1 | Strawberry | 3 | Groundnut | 1 | Annual ryegrass | 2 | Potato | 4 |
| 8 | Wheat | 1 | Cotton | 2 | Hard wheat | 1 | Wheat | 1 | Strawberry | 3 |
| 9 | Bromus | 1 | Oats | 2 | Rice | 1 | Barley | 1 | Annual ryegrass | 2 |
| 10 | Avena strigosa | 1 | Cherry | 2 | Potato | 1 | Oilseed rape | 1 | Blueberry | 2 |

Even though there were bilateral agreements between Argentina and United States and France by which breeders from that countries could protect their varieties in Argentina before its accession to UPOV, for soybean and wheat, as shown in Figures 17 and 18, the contribution of foreign breeders increased after Argentina became a member of UPOV.

Figure 17: Argentina: Varieties Registered – Soybean

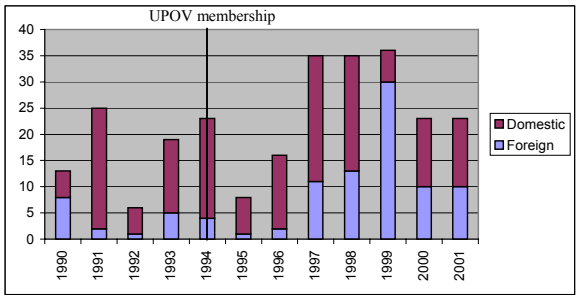
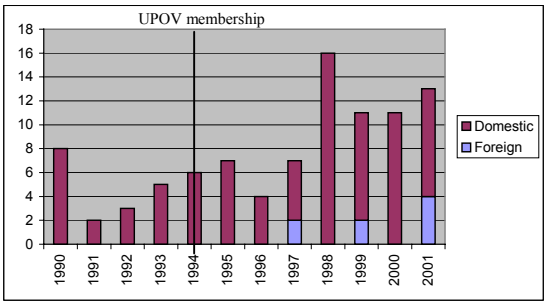



Figure 18: Argentina: Varieties Registered - Wheat




*(ii) Development of Foreign Markets*

As shown in Table 3 and Table 4, soybean is the species for which the largest number of applications have been filed both by residents and non-residents. Argentina is one of the most important soybean exporters in the world, although soybean is a relatively new crop in Argentina. Soybean production increased from 957 tons in 1961 to 26,882,912 tons in 2001 (28,000-fold over 40 years). The introduction of new high-quality varieties keeps the Argentine soybean industry competitive on the world market. Figures 19 and 20 show the increase in the area planted to soybean and the production and export of soybean in Argentina.

Figure 19: Argentina: Area -Soybean

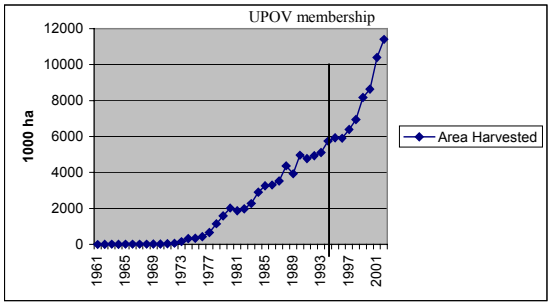
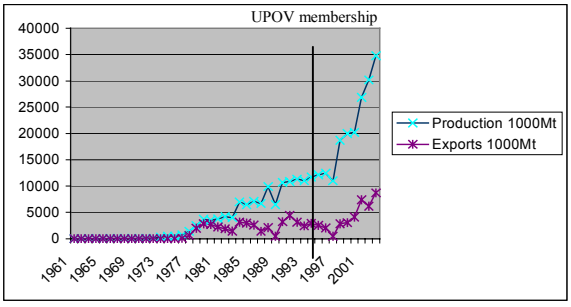



Figure 20: Argentina: Production and Export-Soybean




(c) Domestic Breeding

*(i) Number of Varieties*

As shown in Table 4, new varieties of the most important crops, including soybean, wheat, and maize are bred by residents.

Table 4: Argentina: Number of applications by residents by crops (top 10 crops)

| | 1999 | | 2000 | | 2001 | | 2002 | | 2003 | |
|---|---|---|---|---|---|---|---|---|---|---|
| Order | Crops | No | Crops | No | Crops | No | Crops | No | Crops | No |
| 1 | Soybean | 18 | Soybean | 19 | Soybean | 33 | Soybean | 9 | Soybean | 28 |
| 2 | Wheat | 10 | Lucerne | 5 | Wheat | 8 | Wheat | 9 | Wheat | 10 |
| 3 | Maize | 7 | Wheat | 4 | French Bean | 3 | Lucerne | 3 | Eucalyptus | 10 |
| 4 | Bromus | 4 | Ryegrass p. | 2 | Lucerne | 2 | Groundnut | 3 | Lucerne | 8 |
| 5 | Cocksfoot | 3 | Bromus | 2 | Bromus | 2 | Lotus tenuis | 2 | Nierembergia | 5 |
| 6 | Lucerne | 3 | Fairway Crested Wheatgrass | 2 | Blueberry | 1 | Durum wheat | 1 | Cotton | 4 |
| 7 | Artichoke | 2 | Oats | 2 | Cotton | 1 | *Agropyron scabrifolium* (Doell) *Parodi* | 1 | Bee-still tree | 3 |
| 8 | Trifolium | 2 | French Bean | 1 | Oats | 1 | Oats | 1 | Rescue grass | 1 |
| 9 | Cotton | 1 | | | *Hordeum vulgare* | 1 | Pumpkin | 1 | Rye | 1 |
| 10 | Oats | 1 | | | *Bromus parodii* | 1 | Cebada cervecera | 1 | Guaran | 1 |
| Total of the 10 | | 51 | | 37 | | 53 | | 31 | | 71 |
| Total applications by residents | | 59 | | 37 | | 56 | | 44 | | 72 |

Domestic breeding is also encouraged in some horticultural sectors such as *Nierembergia linearifolia* and *Tecoma sp*. where breeders use domestic genetic resources (see Box 4).

Box 4

The variety Estrella (right) has been developed from national germplasm of *Nierembergia linearifolia* by the National Institute of Agricultural Technology (INTA) and is now protected in Argentina.

Estrella

Figures 21 and 22 show that in the case of certain agricultural crops (soybean and wheat), the domestic breeders' contribution is substantial.

Figure 21: Argentina: Varieties Registered-Soybean

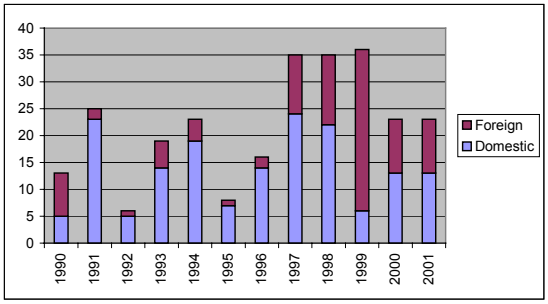
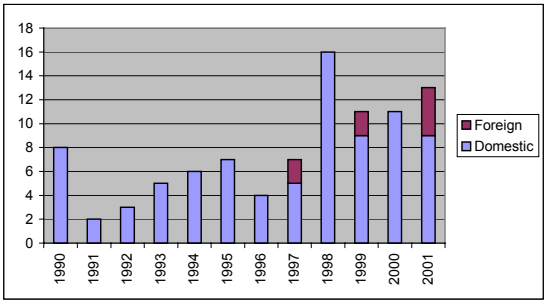



Figure 22: Argentina: Varieties Registered-Wheat




*(ii) Number of Breeders / Investment in Breeding*

Figures 23 and 24 show the change in the number of breeding entities working on soybean and wheat. Creation of INASE and the introduction of Regulatory Decree No. 2183/91 in 1991 and membership of UPOV in 1994 were associated with substantial increases in the number of breeding entities for soybean and wheat. The number of breeders in both the public and private sectors increased.

Figure 23: Argentina: Breeding Entities-Soybean

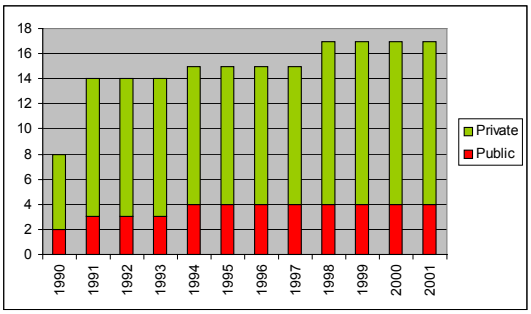
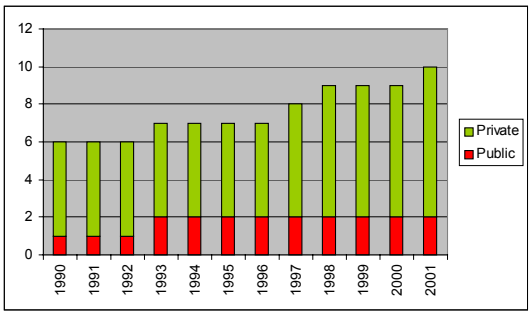



Figure 24: Argentina: Breeding Entities-Wheat




*(iii) Structure of the Breeding Industry*

The introduction of PVP encourages the release of plant varieties into a wide production chain, not only in Argentina but also abroad, broadening the benefit of new varieties. The traditional vertical integration, from breeding to marketing, which used to be predominant in the seed industry in Argentina, has been replaced by the horizontal cooperation between companies licensing products, carrying out joint development and providing services. The movement of germplasm is now more rapid. This can take place, for example, under a licensing agreement where the licensee receives the right to commercialize the protected variety, while the licensing company retains the ownership of the variety (see Box 5).

PVP provides a basis for Technological Relationship Agreements which facilitate public sector institutes or breeding entities to enter the seed business, through cooperation with other national companies (see Box 6).

| Box 5 | Box 6 |
|---|---|
| RELMO is a private company operating a seed business for the major crops such as maize, soybean and wheat in Argentina. RELMO strategically uses license agreements supported by intellectual property rights. RELMO's development is now horizontal with other companies in and outside Argentina. Over the past few years, RELMO has transferred eight varieties to other companies for their commercialization through license agreements, a method whereby they still retain ownership of the varieties. | A Technological Relationship Agreement has been concluded between the National Institute of Agricultural Technology (INTA) and Bioceres S.A., which aims at capacity building of scientists, farmers and seed producers involved in wheat production and the development and commercialization of wheat varieties. INTA is the holder of protection titles of wheat varieties, whereas Bioceres S.A. provides financial support to the INTA wheat breeding program. Bioceres also acts as the exclusive multiplier and commercialization agent for the INTA wheat varieties. In 2004, 10 varieties were commercialized under this Agreement. |

(d) Summary

In the case of Argentina, the adaptation of the national law to the provisions of the 1978 Act of the UPOV Convention and the accession of Argentina to the UPOV Convention in 1994 has had a significant influence on the seed industry. In the operation of PVP in Argentina since 1973, the following effects have been observed:

- Argentina introduced a PVP system in 1973. However, creation of INASE and amendment of the PVP system to be in conformity with the 1978 Act of the UPOV Convention, except for certain aspects concerning foreign applications, was accompanied by a substantial increase in the number of titles granted to domestic breeders. In the 10-year period prior to those developments (1982-1991) the average annual number of titles granted to domestic breeders was 26, which more than doubled to 70 (267%) for the subsequent 10-year period (1992-2001);

- prior to 1994, Argentina provided protection to varieties bred by non-residents on a mutual reciprocity bases (i.e. where Argentinean breeders were able to protect varieties in those other countries), resulting in bilateral agreements in some cases. In 1994, the PVP system in Argentina became fully compatible with the 1978 Act of the UPOV Convention, including with respect to foreign applications, and Argentina acceded to the UPOV Convention. The number of titles granted to non-residents increased in conjunction with those developments. In the 10-year period prior to those developments (1984-1993) the average annual number of titles granted to foreign breeders was 17, which more than trebled to 62 (355%) for the subsequent 10-year period (1994-2003);

- introduction of new, protected varieties from non-resident breeders can be seen in important agricultural crops (e.g. soybean, lucerne), where improved varieties are important for competitiveness in the global market; and in horticultural crops (rose, strawberry);

- increase in the number of domestic breeding entities seen, for example, in soybean and wheat, most of which occurred in the private sector;

- increase of horizontal cooperation in the seed industry, involving foreign seed companies and agreements for technology transfer between national research institutes and breeding entities with other national companies (Technological Relationships Agreements), resulting in more rapid movement of germplasm.

# CHINA

*1. General View of Agriculture in the Country*

Over 66% of China is upland hill, mountains and plateaux with the highest mountains and plateaux found to the west. To the north and east of the Tibetan Plateau, the land descends to the desert or semi-desert areas. In Manchuria (to the northeast) there are broad fertile plains. The southern plains along the east coast of China have rich, fertile soils and are protected from the north winds.

China has a varied climate that can be divided into seven climatic zones. (1) North East China has cold winters while summers are warm and humid. (2) Central China has warm humid summers with the coastal regions occasionally subject to cyclones and typhoons. (3) In South China summers are hot and humid with heavy rainfalls. (4) South West China is mountainous with summer temperatures moderated by altitude, while winters are mild with little rain. (5) The Tibetan region is a high plateau where winters are severe with frequent light snow and frost, while summers are warm during the day with extreme drops in temperature at night. Rainfall is also heaviest in summer. (6) The western interior zone has an arid desert climate with cold winters, and rainfall is distributed evenly throughout the year. (7) Inner Mongolia comprises the mountain ranges and semi-desert lowlands and has an extreme continental climate with cold winters and warm summers. Rainfall is very heavy while strong winds in winter and spring make the temperatures even colder.

In 2004, 49.1% of the work force of China was active in the agricultural sector. Currently, agricultural production is conducted by three different types of farms, namely state-owned farms, collective farms and individual farms. State-owned farms usually conduct large-scale farming adapted for the production of cereals. For example, in Heilonjiang Province in North East China, one of the main maize and soybean producing centers in China, there are 103 large-scale state-owned farms with 300,000 employees working on 2 million hectares of farmland producing 9 million tons of cereals each year. Collective farms are formed usually at county or village levels. Individual farms play an important role in Chinese agriculture. Although many individual farms remain subsistence farms, especially in the inland areas, some individual farms are becoming commercial farms, specialized in horticulture or other highly profitable sectors. The average size of the individual farm is very small (0.5 ha).

Cereal production is the most important sector of Chinese agriculture. Rice is the most important cereal and cultivated in the south, while the center of cultivation of maize, soybean and wheat is to be found toward the north.

Vegetable production represents 18% of the total value of agricultural production in China and now occupies second position in agriculture after cereal production. The farmland used for vegetable production has increased from 4.1 million hectares in 1983 to 14.7 million hectares in 2000. The most important vegetables include Chinese cabbage, cucumber, eggplant, leek, pepper, radish and tomato. Chinese vegetables are now exported to 120 countries, including Japan, the Republic of Korea and South East Asian countries.

Among fruits, apple is the most important and is cultivated mainly in Central China while citrus, the second most important fruit, is produced in Central to South China. Other important fruit crops are banana, grape and pear. The production of all of these crops has doubled over the last decade, to respond to the increased fruit consumption of the Chinese. Chinese fruits are exported to various countries including Japan, Russia and the USA, as well as South East Asian countries.

The flower industry is a relatively new sector which started in the mid-1980's and, recently, has developed quickly in southern Provinces. The Chinese flower industry has a potential market both inside and outside the country.

In the areas of forestry, the Government of China has set a target for forest coverage to increase from 13.92% in 1998 to more than 26% in 2050. The increase of forest coverage for China is particularly important for the prevention of natural disasters such as flood and desertification. To achieve this target, afforestation has been given high priority in the Chinese forestry policy.

Poplar is one of the most important tree species in China. The area of man-made forest of poplar is 7 million hectares. About 60 varieties of poplar are cultivated in China. Poplar is widely used for pulp material, plywood material, etc.

Eucalyptus is another important tree species in China, and its production has developed rapidly in recent years. The area covered by eucalyptus is 1.6 million hectares. Eucalyptus is an important species for pulp and fiber material. 1.2 million tons of eucalyptus is exported annually. About 30 varieties of eucalyptus are cultivated in China.

*2. Short Description of the Seed Industry*

Since the foundation of the People's Republic of China, the development of the seed and breeding industry in China has been determined by various political decisions taken by the Government. In the mid-1950s, a regional trial network of plant breeding was established at State level and at provincial levels. In the 1950s and the early 1960s, seed production in China was characterized by the principle of "self-breeding, self-selection, self-reserve and self-use" supplemented by government redistribution. Under this principle, agricultural production cooperatives were responsible for preparing seeds for their own use. In 1962, the Central Committee of the Communist Party and the State Council issued a Decision on the Enhancement of Seed Work, which required that agricultural research institutes should be strengthened in order to undertake plant breeding and to disseminate quality varieties. Specialized seed companies appeared under this scheme. Foreign investment in the seed and breeding industry became evident in the 1990s.

China's membership of the World Trade Organization (WTO) in 2001 marked the start of the Chinese seed industry to move towards globalization. A first International Forum on the Globalization of China's Seed Industry was held in Beijing on the initiative of the Chinese seed industry in November 2001. It was becoming evident that strong protection of new plant varieties was one of the most important conditions for the globalization of the Chinese seed industry.

The current structure of the seed and breeding industry in China is shown in Table 5 below. Of approximately 11,000 entities, 81.29% are domestic seed companies. Most seed companies, in particular county level seed companies, operate with small assets, and they are increasingly integrated under large-scale domestic or foreign seed companies.

Domestic public institutes and domestic research or educational institutes also play a significant role in the seed and breeding industry, especially in the field of the breeding of major staple crops such as maize, rice, soybean and wheat.

The number of foreign seed companies or joint ventures is still low, however they are active in specific sectors such as vegetable, fruit and flower breeding sectors.
In many cases seed is distributed through small local seed retailers.

Table 5: Structure of the seed and breeding industry in China (2002)

| Categories | Number | Proportion (%) |
|---|---|---|
| Domestic seed company (mainly limited liability companies) including province-owned seed companies and county-owned seed companies | 9,000 | 81.29 |
| Domestic public institutes only for seed propagation | 1,000 | 9.03 |
| Domestic research institutes and domestic educational institutes (mainly concerned with breeding) | 1,000 | 9.03 |
| Foreign seed companies or joint ventures | 72 | 0.65 |
| **Total** | **11,072** | **100.00** |
| Local seed retailers | 100,000 | |

*3. Plant Variety Protection System*

In March 1997, China issued the "Regulations of the People's Republic of China, the Protection of New PVP", based on the 1978 Act of the UPOV Convention. China became a member of the 1978 Act of the UPOV Convention on April 23, 1999.

PVP started to operate in 1999. Two authorities operate separate PVP schemes.

The Ministry of Agriculture is responsible for the protection of new varieties of cotton, fruit trees (except dry fruit), grains, grasses, green manure, hemp, herbaceous medicinal materials, mulberries, oil seeds, ornamental plants (except woody plants), sugar crops, tea shrubs, tobacco and tropical crops such as rubber and vegetables (including water melon and musk melon). Between April 1999 and October 2004 protection has gradually been extended to 41 genera and species. Within the Ministry of Agriculture, the Office for Protection of New Varieties of Plants of the Department of Science, Technology and Education, is responsible for PVP.

The State Forestry Administration is responsible for the protection of new varieties of forest trees, bamboo, and woody rattan, woody ornamental plants (including woody flowers), fruit trees (dry fruit), woody oil-bearing plants, plants used for beverage, plants used for condiments and woody herbs. Between April 1999 and October 2004, protection has gradually been extended to 78 genera or species. The State Forestry Administration has established the Office for the Protection of New Varieties of Plants for the administration of PVP.

Plant genera and species eligible for protection are listed in Tables 6 and 7.

Table 6: China: Genera and species eligible for protection and administered by the Ministry of Agriculture

| 41 genera or species | Date of Publication |
|---|---|
| Rice, Maize, Chinese cabbage, Potato, *Cymbidium goeringii* Rchb. F, Chrysanthemum, Carnation, Gladiolus, Lucerne, Kentucky blue grass | July 16, 1999 (10 genera or species) |
| Wheat, Soybean, Oilseed rape, Peanut, Tomato, Cucumber, Capsicum, Pear, Dock | March 7, 2000 (9 genera or species) |
| *Cymbidium* Sw., Lily, Bird of paradise, Statice | February 26, 2001 (4 genera or species) |
| Sweet potato, Millet, Peach, Litchi, Water melon, Cabbage, Radish | January 4, 2002 (11 genera or species) |
| Sorghum, Barley, *Boehmeria* L., Apple, Citrus, Banana, Kiwifruit, Grape, Plum, Eggplant, Gerbera | July 24, 2003 (11 genera or species) |

Table 7: China: Genera and species eligible for protection and administered by the State Forestry Administration

| 78 genera or species | Date of Publication |
|---|---|
| *Populus tomentosa, Paulownia, Cunninghamia lanceolata, Magnolia, Paeonia suffruticosa, Prunus mume, Rosa, Camellia* | April 22, 1999 (8 genera or species) |
| *Populus, Salix, Castanea mollissima, Eucalyptus, Juglans, Zizyphus jujuba, Diospyros kaki, Prunus armeniaca, Ginkgo biloba, Vernicia, Taxus, Rhododendron, Prunus persica, Lagerstroemia indica, Prunus triloba, Chimonanthus praecox, Osmanthus fragrans* | February 2, 2000 (17 genera or species) |
| *Pinus* Linn., *Picea* Dietr., *Taxodium* Rich., *Sabina* Mill., *Liriodendron* Linn., *Chaenomeles* Lindl., *Acacia* Willd., *Sophora* Linn., *Robinia* Linn., *Syringa* Linn., *Forsythia* Vahl, *Buxus* Linn., *Euphorbia* Linn., *Acer* Linn., *Hippophae* Linn., *Ailanthus* Desf., *Bambusa* Retz. Corr. Schreber, *Indocalamus* Nakai, *Phyllostachys* Sieb. et Zucc., *Calamus* Linn., *Daemonorops* Blume. | December 2, 2002 (21 genera or species) |
| *Cycas* Linn., *Thuja* Linn., *Podocarpus* L'Her. ex Pers., *Betula* Linn., *Corylus* Linn., *Castanopsis* Spach., *Ulmus* Linn., *Zelkova* Spach., *Morus* Linn., *Ficus* Linn., *Paeonia* Linn., *Manglietia* Blume., *Michelia* Linn., *Parakmeria* Hu et Cheng, *Cinnamomum* Trew., *Machilus* Nees., *Loropetalum* R. Br., *Pterocarpus* Jacq., *Zanthoxylum Linn., Clausena Burm. f., Cotinus* Mill., *Euonymus Linn., Koelreuteria Laxm., Ampelopsis* Michx., *Parthenocissus* Pl., *Punica* Linn., *Hedera* Linn., *Ardisia* Sw., *Fraxinus* Linn., *Lycium* Linn., *Catalpa* Linn., *Lonicera* Linn. | October 14, 2004 (32 genera or species) |

The PVP systems have been introduced in China at the strong initiative of the Chinese Government, through cooperation with local Governments. A large number of awareness-raising campaigns at various levels have been organized. Recognition of the PVP system is increasing among Chinese breeders and farmers.

In 2000, the Siping People's Court in Jilin Province (North East China) received the first PVP dispute case. A final agreement was reached by both parties and compensation was paid by

the accused. In 2001, the Supreme People's Court of China issued a judicatory explanation and formulated a series of rules for handling law suits in PVP. Since then, all judgements made by People's Courts at provincial levels have followed these rules. There have been many cases where the rights of PVP holders have been upheld.

The Government of China has now started to consider the benefit of cooperation with the PVP offices of neighboring countries and the benefit of accession to the 1991 Act of the UPOV Convention. Both would lead to a more effective operation of the Chinese PVP systems, thus making it easier for breeders to exercise their rights on varieties.

## *4. Impact of Plant Variety Protection*

### (a) Overall Trends of Varieties Available in the Country

#### *(i) Number of Varieties*

Figures 25 and 26 show the development of the Chinese PVP system in terms of the number of applications, titles granted and titles in force. The high number of applications in 1999, the first year of operation of the Chinese PVP system, can be explained through a high number of applications for protection in certain crops such as maize, peony and rice. This is evidence of a high level of expectation of Chinese breeders for the protection of their varieties prior to their commercialization. The number of applications decreased in 2000 but rebounded in 2001 and continued onwards in 2002. The first PVP title was issued in 1999 and the number of PVP titles in force continues to increase. This reflects the increase of commercially available varieties in China.

Figure 25: China: Number of applications

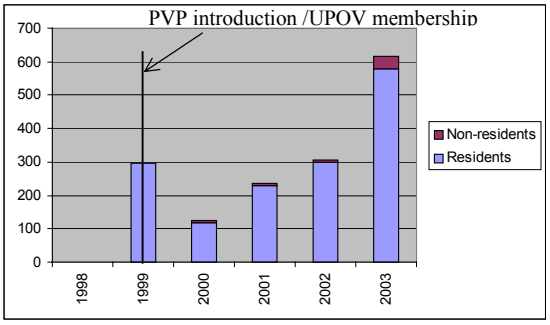
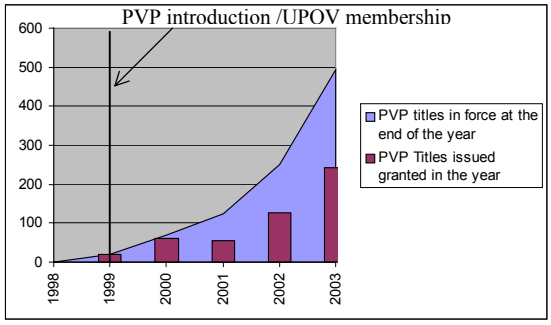



Figure 26: China: Development of the Number of PVP Titles Granted




Figures 27 and 28 show the increase in royalties collected for new varieties of maize and wheat in Henan Province (Central China), indicating a fast diffusion of new varieties and reflecting the increased number of farmers benefiting from the introduction of new varieties. This indicates also the increased awareness among farmers for the benefit of new varieties. Farmers have decided to buy seed of protected varieties, the price of which includes royalties, in anticipation of a higher economic return from the use of better varieties.

Figure 27: China: Royalties Collected in Henan Province (Maize)

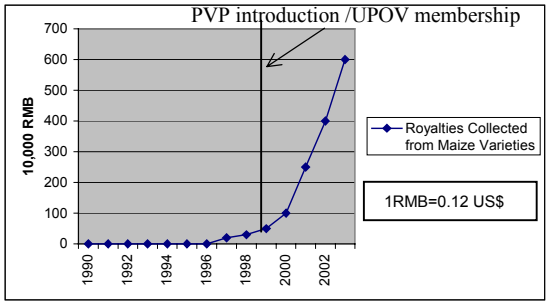
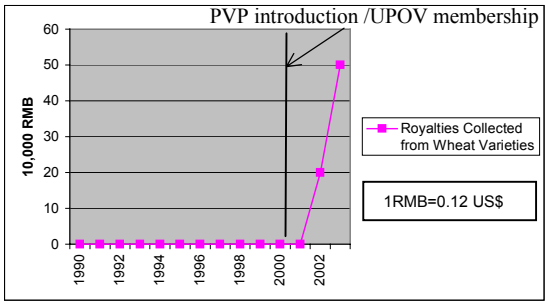



Figure 28: China: Royalties Collected in Henan Province (Wheat)




As shown in Tables 8 and 9, Chinese farmers have seen the development of a number of new varieties of the most important agricultural crops such as maize, rice, wheat soybean and oilseed rape, as well as Chinese cabbage. In the forestry section, the PVP system plays an important role in the continuous development of new varieties of poplar, the most important tree species for the forestry industry (paper and pulp production) and for afforestation in China. Peony, which originates from China and is the Chinese "national flower", as well as magnolia and carmelia are traditionally appreciated in China. The Chinese PVP system also plays an important role in the continuous release of new varieties of these species which represent the traditional Chinese culture (see Box 7).

Table 8: China: Number of titles granted in each year from 1999 to 2003 (agriculture) (top 10 crops)

| | 1999 | | 2000 | | 2001 | | 2002 | | 2003 | |
|---|---|---|---|---|---|---|---|---|---|---|
| Order | Crops | No | Crops | No | Crops | No | Crops | No | Crops | No |
| 1 | | | Maize | 33 | Maize | 7 | Maize | 83 | Maize | 134 |
| 2 | | | Rice | 6 | Rice | 3 | Rice | 20 | Rice | 57 |
| 3 | | | | | Wheat | 8 | Chinese Cabbage | 4 | Wheat | 22 |
| 4 | | | | | Peanut | 4 | Soybean | 3 | Soybean | 16 |
| 5 | | | | | Chinese Cabbage | 3 | Oilseed Rape | 3 | Oilseed Rape | 8 |
| 6 | | | | | Oilseed Rape | 3 | Wheat | 2 | Pear | 6 |
| 7 | | | | | Soybean | 2 | Potato | 1 | Peanut | 5 |
| 8 | | | | | Pear | 2 | Pear | 1 | Water Melon | 3 |
| 9 | | | | | Chrysanthemum | 1 | | | Chinese Cabbage | 2 |
| 10 | | | | | | | | | Dianthus | 2 |
| Total of the 10 | | 0 | | 39 | | 33 | | 117 | | 255 |
| Total titles granted | | 0 | | 39 | | 33 | | 117 | | 261 |

Table 9: China: Number of titles granted in each year from 1999 to 2003 (forestry) (top 5 crops)

| | 1999 | | 2000 | | 2001 | | 2002 | | 2003 | |
|---|---|---|---|---|---|---|---|---|---|---|
| Order | Crops | No | Crops | No | Crops | No | Crops | No | Crops | No |
| 1 | Poplar | 6 | Rose | 10 | Peony | 13 | Chestnut | 1 | Poplar | 6 |
| 2 | | | Magnolia | 8 | Poplar | 2 | | | Apricot | 1 |
| 3 | | | Poplar | 3 | Apricot | 2 | | | | |
| 4 | | | Camellia | 2 | Camellia | 1 | | | | |
| 5 | | | | | Yew | 1 | | | | |
| Total of the 5 | | 6 | | 23 | | 19 | | 1 | | 7 |
| Total titles granted | | 6 | | 23 | | 19 | | 1 | | 7 |

Box 7

The peony variety "Yiengxue" (right) was bred by Mr. Chendezhong, private breeder, and has been granted protection.

The Ministry of Agriculture has estimated that, at the end of 2004, 502 new protected varieties of maize, rice, vegetables and wheat etc. had been planted covering 42,7 million hectares of farmland. The financial benefits the new varieties brought to the holders of breeders' rights are estimated to have reached 1.97 billion RMB (US$ 237 million).

*(ii) Improvement of Varieties*

The introduction of PVP stimulated breeding activities and resulted in the release of improved varieties of various crops which can be used for agricultural (for example, rice; see Box 8), horticultural and forestry (for example, poplar; see Box 9) production.

Box 8:

The rice variety "Yangdao 6" bred by the Lixiahe Agricultural Research Institute in Jiangsu Province, received protection in 2002. This variety is classified in the highest grade by the Ministry of Agriculture. It shows a high resistance to major rice diseases and pests, such as rice blast, bacterial blight, sheath blight and planthoppers. It also has good lodging resistance.

Its yield can reach 9.0 t/ha under normal culture and climate conditions, and has created the yield record of 12.39 t/ha in some fields with good developing capability. (The average rice yield in China in 2004 was 6.347 t/ha (FAO Database)). Furthermore, Yangdao 6 is an outstanding restorer line. As a male parent, it has been used in breeding many hybrid rice varieties, such as Liangyoupeijiu, Yueyou 938, Honglianyou 6, Yangliangyou 6, Xinliangyou 6. Material of Yangdao 6 has been used for sequencing in the China rice genome project. The area of cultivation has reached 4.2 million ha. Its hybrid varieties are planted on 3.3 million ha.

Box 9:

A new triploid poplar variety has been bred by the Beijing Forestry University, showing a high growth rate.

(New triploid poplar variety (left) and conventional diploid poplar variety (right).)

(b) Foreign Investment / International Dimension

*(i) Introduction of Foreign Varieties*

Tables 10 and 11 demonstrate that an influx of foreign applications, as seen in many other countries, was not observed immediately after the accession of China to the UPOV Convention in 1999. This may be partly explained by the fact that foreign seed companies were not familiar with the Chinese seed market which was changing drastically in its nature. Many have not yet established, or are still in the process of establishing, their mechanism to enforce plant breeders' rights in China.

*(ii) Development of Foreign Market*

Tables 10 and 11 indicate also that applications by non-residents are beginning to be filed mainly for horticultural crops, and for ornamental plants in particular. These foreign varieties will strengthen the fast developing Chinese flower industry, providing a greater degree of competitiveness for Chinese growers on the global flower market.

Table 10: China: Number of applications by non-residents by crop (agriculture)

| | 1999 | | 2000 | | 2001 | | 2002 | | 2003 | |
|---|---|---|---|---|---|---|---|---|---|---|
| Order | Crops | No | Crops | No | Crops | No | Crops | No | Crops | No |
| 1 | | 0 | Capsicum | 1 | Pear | 4 | Chrysanthemum | 2 | Chrysanthemum | 2 |
| 2 | | | | | Potato | 2 | Carnation | 1 | | |
| 3 | | | | | | | Lily | 1 | | |
| Total | | 0 | | 1 | | 6 | | 4 | | 2 |

Table 11: China: Number of applications by non-residents by crops (forestry)

| | 1999 | | 2000 | | 2001 | | 2002 | | 2003 | |
|---|---|---|---|---|---|---|---|---|---|---|
| Order | Crops | No | Crops | No | Crops | No | Crops | No | Crops | No |
| 1 | Rose | 1 | Rose | 4 | Azalea | 1 | Rose | 4 | Spurge | 25 |
| 2 | | | | | Rose | 1 | | | Rose | 10 |
| Total | | 1 | | 4 | | 2 | | 4 | | 35 |

(c) Domestic Breeding

*(i) Number of Varieties*

As shown in Tables 12 and 13, new, protected varieties of important agricultural crops, such as rice, maize, wheat and soybean, have been developed by Chinese breeders. The situation is similar in the forestry section, where most applications for species such as peony and poplar have been made by Chinese breeders.

Table 12: China: Number of applications by residents by crops (agriculture) (top 10 crops)

| | 1999 | | 2000 | | 2001 | | 2002 | | 2003 | |
|---|---|---|---|---|---|---|---|---|---|---|
| Order | Crops | No | Crops | No | Crops | No | Crops | No | Crops | No |
| 1 | Maize | 95 | Maize | 58 | Maize | 127 | Maize | 121 | Rice | 253 |
| 2 | Rice | 15 | Rice | 23 | Rice | 60 | Rice | 80 | Maize | 186 |
| 3 | Chinese Cabbage | 4 | Soybean | 13 | Wheat | 10 | Wheat | 30 | Wheat | 54 |
| 4 | Potato | 1 | Capsicum | 5 | Chinese Cabbage | 5 | Water Melon | 12 | Oilseed Rape | 19 |
| 5 | | | Oilseed Rape | 3 | Oilseed Rape | 5 | Oilseed Rape | 11 | Soybean | 11 |
| 6 | | | Wheat | 3 | Peanut | 5 | Pear | 10 | Peach | 6 |
| 7 | | | Chinese Cabbage | 1 | Soybean | 4 | Soybean | 6 | Chinese Cabbage | 5 |
| 8 | | | Peanut | 1 | Pear | 3 | Capsicum | 3 | Cucumber | 5 |
| 9 | | | Pear | 1 | Carnation | 1 | Potato | 3 | Sweet Potato | 1 |
| 10 | | | Tomato | 1 | Capsicum | 1 | Cabbage | 3 | Pear | 1 |
| Total of the 10 | | 115 | | 109 | | 221 | | 279 | | 541 |
| Total applications by residents | | 115 | | 112 | | 221 | | 290 | | 567 |

Table 13: China: Number of applications by residents by crops (forestry) (top 10 crops)

| | 1999 | | 2000 | | 2001 | | 2002 | | 2003 | |
|---|---|---|---|---|---|---|---|---|---|---|
| Order | Crops | No | Crops | No | Crops | No | Crops | No | Crops | No |
| 1 | Peony | 125 | Poplar | 5 | Poplar | 5 | Poplar | 10 | Poplar | 3 |
| 2 | Magnolia | 8 | Yew | 1 | Apricot | 3 | Jujube | 2 | Forsythia | 2 |
| 3 | Poplar | 6 | Chestnut | 1 | | | Apricot | 1 | Eucalyptus | 2 |
| 4 | Plum | 6 | | | | | | | Ailanthus | 1 |
| 5 | Rose | 5 | | | | | | | Chestnut | 1 |
| 6 | Camellia | 3 | | | | | | | Walnut | 1 |
| 7 | | | | | | | | | Lilac | 1 |
| 8 | | | | | | | | | Baldcypress | 1 |
| 9 | | | | | | | | | Locust | 1 |
| 10 | | | | | | | | | Rose | 1 |
| Total of the 10 | | 153 | | 7 | | 8 | | 13 | | 14 |
| Total applications by Residents | | 181 | | 7 | | 8 | | 13 | | 14 |

*(ii) Number of Breeders / Investment in Breeding*

A case study conducted in Henan Province (Central China) showed a clear increase in the numbers of maize and wheat breeders after 1999, the year of the introduction of PVP in China (see Figures 29 and 30).

Figure 29: China: Number of Breeders in Henan Province-Maize

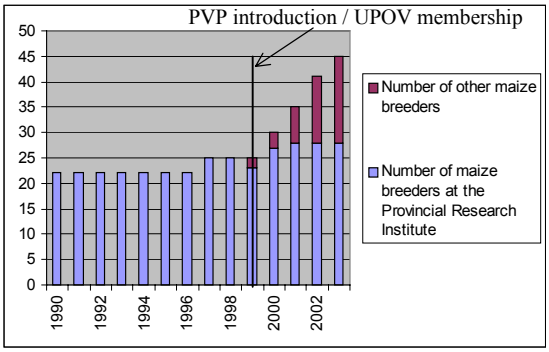
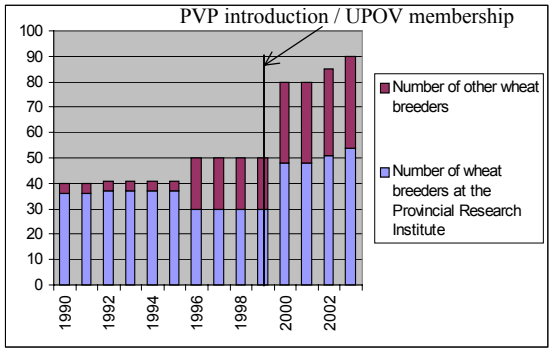



Figure 30: China: Number of Breeders in Henan Province-Wheat




It should also be noted that an increase in the number of breeders has been observed both at the Provincial Research Institute and in other institutions including private companies. In the case of maize, before the introduction of PVP and UPOV membership in 1999, all maize breeders were at the Provincial Research Institute, whereas after 1999 the number of maize breeders started to increase in other institutions. As shown in Figures 31 and 32, the increase in the number of breeders corresponds to the increase in the number of PVP applications for these crops.

Figure 31: China: Number of PVP applications for Maize Varieties in Henan Province

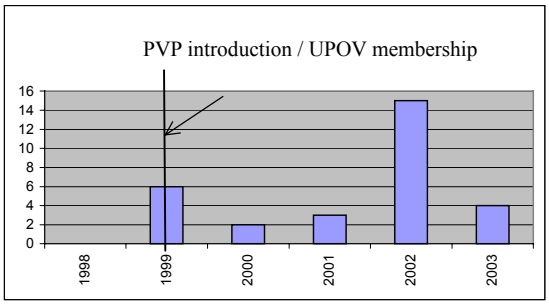
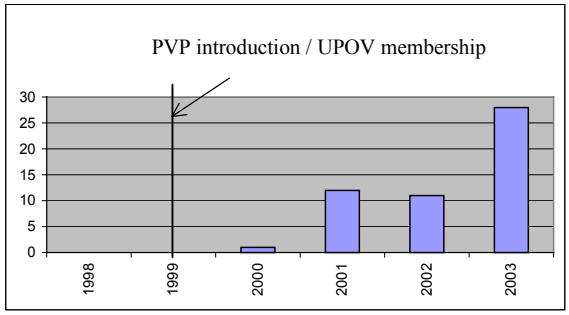



Figure 32: Number of PVP Application for Wheat Varieties in Henan Province




At the national level, large differences in the number of applications in the different provinces can be observed. In general, in the northern provinces, breeders were very interested in protecting their varieties and started to apply for protection immediately after the introduction of the PVP system in 1999. However, in the other provinces breeders were only just starting to apply for protection in 2001 or 2002. This resulted from the different measures taken at the Provincial level for raising awareness of the importance of PVP. Now breeders all over the country will be well informed and this is expected to lead to a continuing increase in the number of domestic PVP applications.

*(iii) Structure of the Breeding Industry*

Figures 33 and 34 show the number of applications by categories of applicants between 1998 and 2003 in the agriculture and the forestry sectors. In the agricultural sector, public research institutes have made the most applications, followed by seed companies. Agricultural universities also play an important role. In the forestry sector, no clear trend can be observed among domestic breeders, while the number of applications by foreign entities in 2003 may be a sign of an increasing number of foreign applications in the forestry section, especially for ornamental varieties, such as rose.

Figure 33: China: Number of Applications by Categories of Applications (Agriculture)

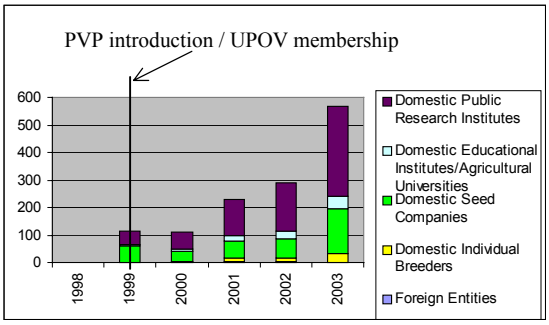
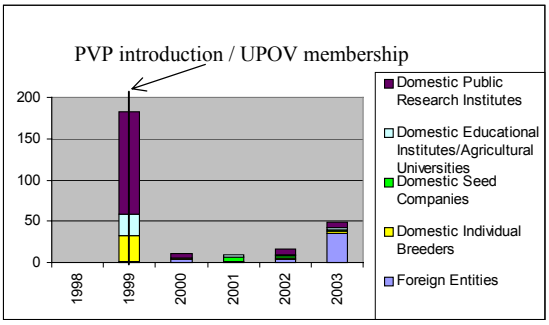



Figure 34: China: Number of Applications by Categories of Breeders (Forestry)




Chinese seed companies have become aware of the value of high-quality varieties and the importance of the protection of breeders' rights, which play a key role in the development of the seed business (see Boxes 10 and 11).

Box 10

Mr. Huang Xilin, an executive of the Beijing Origin Seed Technology Inc, explained that his company had developed from a small firm into a seed supplier with seven subsidiaries in various provinces including Henan, Sichuan and Shandong. The company sells seeds of six new varieties which hold PVP titles, including hybrid maize varieties "Yuyi 22" and "Lin'ao 1", which have become extremely popular in China. The economic returns have encouraged his company to invest more funds into the research and development of new varieties of plants. The company has invested 30 million yuan (RMB) (US$3.61 million) in establishing breeding bases in Beijing, Chengdu (capital of Sichuan Province) and the Hainan Province.

Box 11

Shandong Denghai Seeds Co., Ltd. (Denghai Seeds) was founded in December 2000. Over the last 3 years, Denghai Seeds has distributed 102,732 tons of hybrid seed of maize, with a revenue of US$91,525,000 and a net profit US$28,702,000. The total area planted is 2,054,600 ha. By late April 2005, Denghai Seeds had put forward applications for protection for 60 new plant varieties and had been granted titles for 30 of those. The main products of Denghai Seeds, Denghai 11 and Denghai 13, have already been granted protection.

Denghai 11 (DH11) has been granted protection (CNA20000096.9) and has been approved by the National Crop Variety Approval Committee (Code: 2001005). "DH11" has big ears and is widely adapted. It is suitable for the summer maize area, southwest China, and the planting population is 42,000-45,000/ha.

Denghai 13 (DH13) has been granted protection (CNA20000097.7) and has been approved by the National Crop Variety Approval Committee (Code: 2003012). "DH13" is a high-yield and disease-resistant variety. It is widely adapted and is suitable in summer maize area, northwest China, southwest China, and spring maize area. The planting population is 45,000-49,500/ha.

On the occasion of the fifth anniversary of the Chinese PVP system in June 2004, a total of 20 entities (including agricultural research centers, agricultural universities and private companies) were rewarded as pioneers, for their most efficient use of the PVP system in their breeding strategies[1]. Four cases are summarized in Boxes 12 to 15.

Box 12

The Chinese Paddy Rice Research Institute has filed 13 PVP applications for its new rice varieties. 3 titles have been granted. The rice variety "Zhong9A" was granted protection in 2000. Its economic value is estimated at some 2 million RMB (approximately US$240,000) and is considered to be one of the most successful rice varieties in China. The protection facilitated the expeditious diffusion of Zhong9A through exhibition fields established by the local Governments of Guanxi, Anhui, Guangdong, Hubei and Sichuan.

Box 13

The Chinese Agriculture University developed the hybrid maize variety "Nongda108" and received protection for its parental varieties "HuangC" and "X178." 2,740,000 ha were planted with Nongda108 in 2002, covering 11% of the total production area of maize in China. Every year the University receives US$1,200,000 in royalty revenue. PVP ensures the University's control on the quality of Nongda108 seed on the market, protecting the interest of users.

[1] Published by the Department of Science, Technology and Education of the Ministry of Agriculture, June 2004.

Box 14

The Shenyang Agricultural Academy of Sciences is the holder of titles of protection for more than 20 maize hybrid varieties. The Academy has received more than US$ 5 million through PVP. PVP facilitates the commercialization of new varieties. In the case of the maize variety "Shen Dan 16", the commercialization of seeds increased from 1,000 tons in 2001 to 2,500 after the Academy received a PVP title. 65 enterprises were given the right to produce and sell seeds of this variety, paying US$1.3million for the production of seeds to cover 45.8 million ha.


Box 15

Henan Xinxiang Academy of Agricultural Sciences is a local research institute in agriculture, with well developed disciplines and advanced breeding capability. At present, applications for protection have been filed for 13 new varieties developed at the institute, for example:

The wheat variety "Xinmai-18" was granted protection. It has been sold in the Henan, Jiangsu, Hubei, Shandong, Hebei and Shanxi Provinces with a total sale of 16,000 tons. Xinmai-18 was planted with an acreage of 2,100 ha

The maize variety "Xindan-22" was granted protection in 2002. In 2004, the right to sell the variety was transferred to Gansu Dunhuang Seeds Co. Ltd. at a price of 4.3 million RMB (approximately US$516,000). So far, this variety has been distributed in the Henan, Shanxi, Guangxi, Hebei, Anhui, Jiangsu, Shandong and Gansu Provinces and other provinces with an acreage of over 46,700 ha, and has increased the total yield of corn by 700,000 tons.


(d) Summary

China's PVP systems have only been in operation for 5 years and it is not yet possible to evaluate their full impact. Nevertheless, the following effects have been observed:

- rapid uptake by farmers of new, protected varieties seen, for example, in maize and wheat in Henan Province: Farmers have decided to buy seed of protected varieties, the price of which includes royalties, in anticipation of a higher economic return from the use of better varieties;

- new, protected varieties have been introduced for major staple crops (e.g. rice, maize, wheat), horticultural crops (e.g. rose, Chinese cabbage, pear), including traditional flowers (e.g. peony, magnolia, camellia) and for forest trees (e.g. poplar);

- start of an introduction of new, foreign varieties, in particular for ornamental varieties;

- stimulation of commercial breeding activities in domestic public research institutes and domestic seed companies, with an increase in the number of breeders (e.g. maize and wheat in Henan Province) linked to increased numbers of PVP applications;

- income generation for breeders, including public research institutions and agricultural universities, and encouragement of further investment in plant breeding.

Providing information and raising awareness of the PVP system for breeders, potential new breeders and users have been seen to be important measures for a rapid impact.

# KENYA

## *1. General View of Agriculture in the Country*

Kenya is located in Eastern Africa and its climate varies from a tropical climate on the coast, characterized by hot and humid conditions, to a temperate climate inland and a dry climate in the north. Over 70% of the country is arid, receiving less than 510 mm of annual precipitation, with greatest rainfall in the highlands.

Approximately 7 million hectares in the medium to high rainfall areas are used for agricultural production. The agricultural sector is the backbone of the national economy, contributing directly 26% of GDP and 60% of the export earnings. Within the agriculture sector, a sharp contrast can be observed between the cash crop sector and the staple crop sector.

Kenya is one of the most important producers world-wide of industrial crops such as coffee, pyrethrum (largest producer in the world), sisal and tea. Those crops were introduced to Kenya at the beginning of 20th century as plantation crops. Systematic research work conducted on these crops resulted in their successful introduction and adaptation in Kenya. The cultivation of these crops is mainly in the hands of commercial farmers or enterprises and is conducted on a relatively large scale.

The production of vegetables, fruits and ornamental plants for export to European countries has recently increased. Flower production is the newest and most rapidly developing agricultural sector in Kenya. Kenya is the largest exporter of cut flowers to Europe. Rose is the most important export item, followed by chrysanthemum.

Staple crop production, for crops such as cassava, maize, rice, sweet potato and wheat, is conducted mainly by subsistence farmers to fulfil the national demand. Kenya needs to import rice and wheat to meet its national requirements.

## *2. Short Description of the Seed Industry*

Development of the seed industry in Kenya started in the early 20th century and was supported by research on food, industrial and export crops.

Commercial seed business started with the establishment of the Kenya Seed Company (KSC) in 1956 for the production of pasture seed. KSC continued to play a dominant role until the industry was partially liberalized in the mid 1980s. The seed industry was fully liberalized in 1996. Since then, several companies have entered the seed business and there were 46 registered seed companies in 2004, dealing in cereals (barley, maize, oats, sorghum, triticale and wheat), horticultural seeds, Irish potatoes, oil crops (rapeseed, sunflower), pasture seeds, pulses and vegetables. About 20% of the seed and other propagating material planted in Kenya is distributed through commercial channels. The Government conducts basic research to support this sector.

Many planting materials and seed are distributed through non-commercial channels, such as farmer-to-farmer exchange. Farm-saved seed is largely used by local farmers. Various non-

governmental organizations (NGOs) also play an important role in the distribution of non-commercial seed.

The Ministry of Agriculture has the main responsibility for creating and promoting an enabling environment for the players in the seed industry, through the development of policies and strategies.

Research institutions involved in the development of varieties include: the Kenya Agricultural Research Institute (KARI), for food crops, horticultural crops, industrial crops, pasture and fodder crops; the Kenya Forestry Research Institute (KEFRI) for trees; and commodity research institutions, such as the Coffee Research Foundation (CRF), the Pyrethrum Board of Kenya (PBK), the Kenya Sugar Research Foundation (KESREF) and the Tea Research Foundation of Kenya (TRFK).

The Kenya Plant Health Inspectorate Service (KEPHIS) was established in 1996 as the national regulatory agency responsible for variety evaluation, release, and registration; PVP; seed certification; plant protection; and development and implementation of seed standards.

The Plant Breeders Association of Kenya (PBAK) was founded in 1994 and officially registered in 1996. PBAK provides plant breeders with information and technical support as well as advice for the protection of intellectual property rights. It also advises the Government on matters concerning variety evaluation and release, seed quality control and the conservation, exchange and use of plant genetic resources.

### *3. Plant Variety Protecton System*

In Kenya, provisions for the protection of plant varieties were first introduced by the Seeds and Plant Varieties Act of 1972. That Act provided for the grant of proprietary rights to persons having bred or discovered new varieties of plants. The Act was revised in 1991, while in 1994 regulations for the implementation of PVP were introduced and the PVP scheme started to operate in 1997.

Kenya acceded to the 1978 Act of the UPOV Convention on May 13, 1999. Currently, the legislation is being revised with a view to accession to the 1991 Act of the UPOV Convention, recognizing emerging national and international developments in the seed industry.

Kenya grants plant breeders' rights for all plant genera and species other than algae and bacteria.

### *4. Impact of Plant Variety Protection*

#### (a) Overall Trends of Varieties Available in the Country

##### *(i) Number of Varieties*

As shown in Table 14 and Figure 35, a total of 611 applications for PVP were received after the PVP system in Kenya became operational in 1997. The surge in PVP applications from local breeders in 2001 reflected an increased awareness among breeders in public institutions

of the benefits of protecting their varieties. Breeders based in Kenya have submitted 275 (45%) of the total PVP applications, while 336 (55%) have been from non-resident breeders.

The first protection title in Kenya was granted in 2003. 109 varieties received protection titles in that year. It should be noted that those varieties had been provisionally protected between the time of application and the time of the grant of protection, in accordance with the protective directive provision of the PVP Law of Kenya.

Table 14: Kenya: Number of Applications

| Year | Number of Applications | | |
|---|---|---|---|
| | Resident | Non-resident | Total |
| 1997 | 11 | 128 | 139 |
| 1998 | 42 | 33 | 75 |
| 1999 | 16 | 45 | 61 |
| 2000 | 24 | 45 | 69 |
| 2001 | 164 | 33 | 197 |
| 2002 | 11 | 27 | 38 |
| 2003 | 7 | 25 | 32 |
| Total | 275 | 336 | 611 |

Figure 35: Kenya: Number of Applications

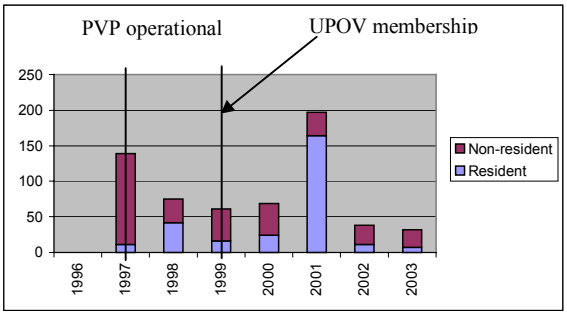



Table 15 shows the crop species for which the largest numbers of applications for protection were filed between 1997 and 2003.

Table 15: Kenya: Numbers of Applications by crop (top 11 crops) (1997-2003)

| | Plant Species | Number of Applications |
|---|---|---|
| 1 | Rose | 247 |
| 2 | Maize | 55 |
| 3 | Tea | 33 |
| 4 | Wheat | 30 |
| 5 | Alstroemenia | 28 |
| 6 | Pyrethrum | 23 |
| 7 | Limonium | 14 |
| 8 | Rape Seed | 14 |
| 9 | Dry Bean | 13 |
| 10 | French Bean | 14 |
| 11 | Macadamia Nut | 11 |
| Total | | 485 |

The number of applications for rose represents 40.4% of the total applications for protection. All are foreign-bred varieties. It should be noted that the introduction of foreign rose varieties into Kenya increased in parallel to the introduction of the PVP system.

An increased number and range of improved varieties have become available to the farmers. As shown in Table 16, the number of varieties released within the period subsequent to the establishment of PVP is significantly higher than the preceding period, especially for maize. Kenya operates a national register, which is an official list of varieties whose seed can be legally produced and marketed in Kenya. It should be noted that, for agricultural crops, one of the requirements, in order for a variety to be included in the national register, is that it must

demonstrate that it has value for cultivation and use (VCU). As shown in Table 16, during the period 1990-1996, only 38 new varieties were released as compared to 136 during the period 1997-2003. Maize constituted about 50% of these varieties. Most of the new varieties are superior to the existing ones, particularly in yield, pest and disease tolerance, nutritional qualities, early maturity and tolerance to abiotic stresses. Since maize is a staple food for 80% of Kenyans, this implies a positive contribution to food security in the country.

Table 16: Kenya: Number of varieties registered between 1990-96 and 1997-2003

| Crop | 1990-96 | 1997-2003 |
|---|---|---|
| Macadamia | - | 4 |
| Tea | 11 | 5 |
| Sweet potato | - | 8 |
| Sugarcane | 3 | 10 |
| Cassava | - | 3 |
| Irish Potato | - | 2 |
| Maize | 7 | 60 |
| Pyrethrum | - | 11 |
| Cotton | - | 1 |
| Millets | 1 | 6 |
| Sorghum | 3 | 6 |
| Barley | 2 | 2 |
| Wheat | 2 | 10 |
| Beans | 7 | 4 |
| Pigeon peas | 1 | 2 |
| Mung beans | 1 | 2 |
| Total | 38 | 136 |

*(ii) Improvement of Varieties*

The introduction of PVP stimulated breeding activities for various crops, in ways which are illustrated below:

*Maize*

All newly released, protected maize varieties have enhanced tolerance/resistance to northern leaf blight and grey leaf spot fungus. A number of introduced lines and varieties are being evaluated and used for breeding high-quality protein maize varieties with resistance to abiotic and biotic stresses.

*Tea*

Research activities on tea, including breeding, is undertaken by the Tea Research Foundation of Kenya (TRFK), established in 1980 with funding from all the tea stakeholders through a levy charged. Since then other companies have established their own tea breeding sections and have been able to produce varieties.

*Pyrethrum*

The Pyrethrum Board of Kenya, with its 25 nurseries spread out in the pyrethrum growing areas, is responsible for providing planting materials of pyrethrum to growers. Breeding of new varieties of pyrethrum is conducted jointly by the Pyrethrum Board of Kenya and KARI.

(b) Foreign Investment / International Dimension

*(i) Introduction of Foreign Varieties*

As shown in Table 17, varieties of horticultural crops have been introduced mainly by foreign breeders. It shows a strong interest of foreign breeders to introduce their varieties in Kenya. Most of them are ornamental varieties (rose in particular) and their introduction has contributed to the diversification of the horticultural sector of Kenya and to the development of trade in horticultural product, in particular ornamental plants, with European and other global markets.

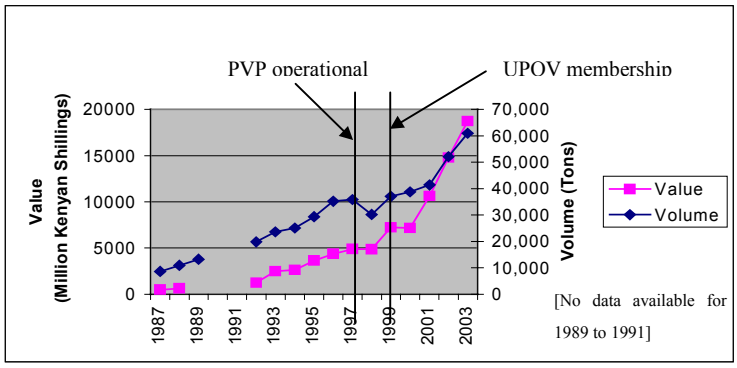
Table 17: Kenya: Distribution of PVP applications for horticultural crops (1997-2003)

| Crop | Category | Source of Application | | | | Total |
|---|---|---|---|---|---|---|
| | | Non-residents | Residents | | | |
| | | | Public | Private | Joint public & private | |
| Strawberry | Fruit | 3 | - | - | - | 3 |
| Passion fruit | Fruit | 1 | - | - | - | 1 |
| Raspberry | Fruit | 1 | - | - | - | 1 |
| Alstroemeria | Ornamental | 28 | - | - | - | 28 |
| Aster | Ornamental | 1 | - | - | - | 1 |
| Carnation | Ornamental | 2 | - | - | - | 2 |
| Eryngium | Ornamental | 1 | - | - | - | 1 |
| Gysophila | Ornamental | 5 | - | - | - | 5 |
| Limonium | Ornamental | 8 | - | 6 | - | 14 |
| Pelagornium | Ornamental | 4 | - | - | - | 4 |
| Phlox | Ornamental | 4 | - | - | - | 4 |
| Rose | Ornamental | 247 | - | - | - | 247 |
| Solidago | Ornamental | 2 | - | - | - | 2 |
| Tagetes | Ornamental | 1 | - | - | - | 1 |
| Calla Lilly | Ornamental | 7 | - | - | - | 7 |
| Amaranthus | Vegetable | - | - | 4 | - | 4 |
| Rape seed | Vegetable | 14 | - | - | - | 14 |
| Pepper | Vegetable | 1 | - | - | - | 1 |
| Sweet potato | Vegetable | 1 | - | - | - | 1 |
| Tomato | Vegetable | - | - | 1 | - | 1 |
| Irish potato | Vegetable | - | 4 | - | - | 4 |
| French bean | Vegetable | 14 | - | - | - | 14 |
| Total | | 345 | 4 | 11 | | 360 |

*(ii) Development of Foreign Market*

As indicated in Figure 36, the export of ornamental plants has increased rapidly over the last 15 years. This has coincided with the increased number of applications for protection of varieties either filed or granted in Kenya. As shown in Table 17, most of the applications for protection of varieties of ornamental plants in Kenya are of foreign origin. The introduction of foreign varieties has contributed to the increased competitiveness of Kenyan flower industry on the European market. The export of Kenyan cut flowers to the European market has increased from 129 million Euros in 1999 to 208 million Euros in 2003. There has also been an expansion of trade with the Middle East and prospects of expanding to the US markets are underway. This provides the Kenyan economy with an important source of foreign exchange earnings, and a source of income for the development of the rural economy.

Figure 36: Export of Kenyan Cut Flowers




*(ii) Breeder's Exemption*

PVP under the UPOV Convention allows the use of protected varieties for breeding other varieties under the principle of breeder's exemption. For example, a foreign French bean variety introduced into Kenya was used by Kenyan breeders for further breeding purposes (see Box 16). Introduced foreign varieties are widely used for the breeding of new vegetable and fruit varieties adapted to the Kenyan environmental conditions while corresponding to the demand of European and Near-Eastern consumers.

Box 16


A French bean researcher working at the Moi University has developed a successful commercial variety "Line 10" (right) on the basis of the variety "Amy" introduced from the Netherlands. "Amy was granted a provisional protection title in Kenya on July 26, 1999. An application for protection for "Line 10" has been filed.

Line 10

(c) Domestic Breeding

*(i) Number of Varieties*

As shown in Table 18, applications for protection of varieties of agricultural crops have been filed mainly by domestic breeders. Public breeding institutions play an important role for crops such as maize, pyrethrum and tea. For maize and tea, private breeders are also active. Furthermore, a number of new varieties are bred jointly by private and public breeders for crops such as wheat, maize and dry beans. Crops such as cassava, maize, millet, sorghum, sweet potato and wheat are widely used by local (subsistence) farmers to feed their family members. As PVP titles for these varieties are in many cases in the hands of public institutions, local farmers can use the propagating material of the protected varieties under privileged conditions, for example, subsistence farmers exchange seed among themselves.

Table 18: Kenya: Distribution of PVP applications for agricultural crops (1997-2003)

| Crop | Category | Source of Application | | | | Total |
|---|---|---|---|---|---|---|
| | | Foreign | Local | | | |
| | | | Public | Private | Joint public & private | |
| Oat | Cereal | - | 1 | - | - | 1 |
| Finger millet | Cereal | - | - | - | 2 | 2 |
| Barley | Cereal | - | - | 7 | - | 7 |
| Proso millet | Cereal | - | - | - | 1 | 1 |
| Pearl millet | Cereal | - | 3 | - | - | 3 |
| Sorghum | Cereal | - | 3 | - | 4 | 7 |
| Wheat | Cereal | - | 4 | 2 | 24 | 30 |
| Maize | Cereal | - | 27 | 14 | 14 | 55 |
| Tea | Industrial | - | 12 | 21 | - | 33 |
| Pyrethrum | Industrial | - | 23 | - | - | 23 |
| Coffee | Industrial | - | 4 | - | - | 4 |
| Cotton | Industrial | - | 1 | 1 | - | 2 |
| Macadamia nut | Industrial | - | 4 | 7 | - | 11 |
| Sugarcane | Industrial | - | 6 | - | - | 6 |
| Safflower | Oil | - | 1 | - | - | 1 |
| Sunflower | Oil | - | 5 | 5 | - | 10 |
| Castor oil | Oil | - | 2 | - | - | 2 |
| Soybean | Oil | - | 7 | - | - | 7 |
| Bracharia | Pasture | - | 1 | - | - | 1 |
| Rhodes grass | Pasture | - | 5 | - | - | 5 |
| Guinnea grass | Pasture | - | 1 | - | - | 1 |
| Setaria | Pasture | - | 2 | - | - | 2 |
| Clover | Pasture | - | - | 1 | - | 1 |
| Pigeon pea | Pulse | - | 4 | - | - | 4 |
| Dolichos bean | Pulse | - | 2 | - | - | 2 |
| Runner bean | Pulse | - | - | 1 | - | 1 |
| Dry beans | Pulse | - | 6 | 1 | 6 | 13 |
| Peas | Pulse | 7 | - | - | - | 7 |
| Cow pea | Pulse | - | 3 | 1 | - | 4 |
| Mung bean | Pulse | - | 2 | 1 | - | 3 |
| Cassava | Root crop | - | 2 | - | - | 2 |
| Total | | | 131 | 61 | 51 | 251 |

*(ii) Number of Breeders / Investment in Breeding*

As shown in Table 19, since the introduction of PVP the number of breeding entities has doubled. It is important to note that some entities are involved in breeding for several crops or commodities. Similarly, research institutes such as KARI have several stations developing different products of the same commodity, i.e. maize for the dry zones is handled by one station, while high altitude maize varieties are developed by a different station in an appropriate region.

Table 19: Kenya: Number of breeding entities per crop for the period 1990-96 and 1997-2003

| Crop | 1990-96 | 1997-2003 |
|---|---|---|
| Maize | 9 | 16 |
| Dry Beans | 5 | 9 |
| French Beans | 1 | 4 |
| Macadamia | 1 | 2 |
| Tea | 2 | 5 |
| Sweet Potato | 3 | 4 |
| Sugar cane | 1 | 1 |
| Cassava | 3 | 4 |
| Irish Potato | 1 | 1 |
| Pyrethrum | 1 | 2 |
| Sunflower | 2 | 5 |
| Cotton | 1 | 2 |
| Millet | 2 | 4 |
| Sorghum | 3 | 8 |
| Barley | 1 | 2 |
| Rice | 1 | 3 |
| Wheat | 2 | 5 |
| Cow Peas | 2 | 4 |
| Total | 41 | 81 |

*(iii) Structure of the Breeding Industry*

As shown in Table 18, public and private breeders have started to jointly develop new varieties for some crops, such as wheat and maize. PVP plays an important role in promoting this kind of public-private cooperation.

It has been observed that some university scientists previously conducting academic work, have started to breed commercial varieties, thereby increasing the number of de facto commercial breeders. (see Boxes 17 and 18).

Another type of cooperation is developing between international research institutes under the Consultative Group on International Agriculture Research (CGIAR) and local seed companies, whereby the latter would undertake the commercialization of varieties bred by the former. PVP is expected to play an important role and its modalities are now under discussion (see Box 19).

The PVP system encourages also local breeders including private farmer-breeders to establish and commercialize new varieties (see Box 20).

Box 17: **Dry/Field Beans**

Field evaluation of bean varieties bred by professors of Egerton and Nairobi Universities that are to be released and protected. Previously these professors did breeding work purely for publication and scientific purposes.

Box 18: **Climbing beans**

Climbing beans are new types of beans that are suitable for small holder farmers. These are being bred under institutional and regional collaboration projects involving both university breeders and KARI breeders.

Varieties are being evaluated here for suitability for release and protection.

Box 19

Three varieties of "Quality Protein Maize" have now been released in Kenya through collaborative work between local seed companies, research institutes and the International Maize and Wheat Improvement Center (CIMMYT). These varieties have higher levels of tryptophane and lysine compared to normal maize varieties, thus providing high quality protein for human consumption and for animal feed. PVP facilitates this kind of cooperation by allowing the varieties to be commercialized in a way which ensures that all partners are rewarded for their work.

Box 20

**Betsy** : a strelitzia variety selected by Mrs. Muriithi (right). Mrs. Muriithi's application for PVP is under examination.

(d) Summary

In the 7 years (1997 to 2004) since the PVP system was introduced in Kenya, and since 1999 when Kenya acceded to the UPOV Convention, the following impacts have been observed:

- significantly higher number of varieties developed and released in the six-year period after the introduction of PVP (1997-2003), compared to the previous six-year period (1990-1996), across a number of agricultural crops and for maize in particular;

- increased introduction of foreign varieties, especially in the horticultural sector, which contribute to the diversification of the horticultural sector (for example the emergence of the flower industry) and support the competitiveness of Kenyan products (cut flowers, vegetables and industrial crops) in global markets;

- increased introduction of foreign germplasm in the form of new, protected varieties (especially of horticultural crops) which has been used by Kenyan breeders for further breeding;

- increase of the number of Kenyan-bred varieties of agricultural crops with improved performance (e.g. yield, pest and disease tolerance, nutritional qualities, early maturity and tolerance to abiotic stresses) for local farmers including subsistence farmers. PVP titles for many Kenyan-bred varieties are in the hands of public institutions and local farmers can use the propagating material of the new, protected varieties under privileged conditions; for example, subsistence farmers have been permitted to exchange seed among themselves;

- facilitation of public / private partnerships for plant breeding, including partnership between international research institutes (CGIAR) and Kenyan seed companies, and emergence of new types of breeders (university researchers, private farmer-breeders).

# POLAND

## 1. *General View of Agriculture in the Country*

The majority of the territory of Poland is found in the Great European Plain. In the north of the Polish Plateau there are lowlands of clay and sand as well as the Baltic Sea coast, which is flat and contains numerous lakes. To the south, the plateau rises to the Carpathian and Sudetes Mountains.

Due to its geographical location, the climate in Poland is characterized by wide variations in the length of particular seasons. The climate is variable: from European continental in the east (rather dry summers and cold winters) to moderate western-European with Atlantic influence (in the west). The average annual temperature ranges from 6°C to 8.8ºC; the average annual precipitation is 500-600 mm in the lowlands and 1200-1500 mm in the uplands and mountains.

More than half the land is used for agriculture. Transition to a market economy started in 1989 and 1990, and had an impact on the agricultural sector in Poland. Agricultural production is based mainly on small, independent farmers with an average farm size of 8.3 ha (2002) (see Table 20).

Table 20: Structure of farms in Poland

| Area (ha) | Number of farms | % |
|---|---|---|
| 1 to 2 | 517,000 | 26.5 |
| 2 to 5 | 629,800 | 32.1 |
| 5 to 10 | 426,800 | 21.9 |
| 10 to 20 | 266,600 | 13.6 |
| 20 to 50 | 96,000 | 4.9 |
| 50 and more | 19,900 | 1.0 |

In preparation for Poland's entry into the European Union, substantial reforms were undertaken in the agricultural sector. The main agricultural products are: cereals, such as barley, beet, oilseeds, potatoes, rye and wheat.

## 2. *Short Description of the Seed Industry*

The breeding and seed industry in Poland emerged in the middle of the 19th century. The basic rules of the national seed systems were established before 1938 and were characterized as a self-governing system based on private breeding and seed companies, voluntary variety listing and seed certification. The system was supervised by the Polish Seed Trade Association and Regional Agriculture Chambers. Seed had been exported from Poland since the 19th century, with sugar beet seeds being one of the most important export items.

After World War II, breeding and seed companies were nationalized, and a state-owned, centralized seed system was introduced. That seed system was characterized by the separation of plant breeding from seed production and trade. Listing of varieties of agricultural plants and vegetables eligible for marketing became mandatory in 1955. The listing of ornamental varieties and fruit varieties was introduced in 1970 and 1988, respectively.

A PVP system was introduced in 1987. In 1990, a series of reforms to adjust the Polish seed scheme to a market economy were implemented. Centralized management of plant breeding was dissolved and state-owned breeding and seed establishments were liquidated into limited liability companies, the shares of which, however, still remained in the hands of the Government.

Now, plant breeding companies, most of which are State-owned, conduct breeding activities for the most important agricultural and vegetable crops. The State-owned companies belong either to the Agricultural Property Agency or to the Plant Breeding and Acclimatization Institute (IHAR). Seed production is conducted by a number of private and State-owned entities. Their production is now much smaller than it used to be, in particular, in comparison to that of the 1980s, a period during which Poland was an eminent seed producer both on the domestic and international markets. This decrease resulted from the structural changes introduced during the period of the transition to a market economy

*3. Plant Variety Protection System*

PVP was introduced in 1987 by the enactment of the Seed Industry Law of October 10, 1987. Poland became a member of UPOV on November 11, 1989. The Law was amended on November 24, 1995, according to the provisions of the 1991 Act of the UPOV Convention. Since August 15, 2003, Poland has been party to the 1991 Act of the UPOV Convention. The Law of June 26, 2003, on the Legal Protection of Plant Varieties entered into force on May 1, 2004, when Poland joined the European Union.

Poland grants plant breeders' rights to all plant genera and species.

The Research Centre for Cultivar Testing (COBORU) is responsible for all tasks related to PVP in Poland. The Variety Listing and Protection Office is responsible for receiving applications, maintaining the Plant Breeders' Rights Register and publishing official information. The DUS Testing Department conducts all DUS trials and prepares official descriptions of varieties. The decision on the grant of PVP is taken by the General Director of COBORU.

Since Poland joined the European Union, protection of new varieties of plants can be granted either through the Polish national PVP system or through the PVP system of the European Community, which is operated by the Community Plant Variety Office (CPVO). A PVP title granted by the CPVO is valid in all 25 member States of the European Union. In cases where the breeder of a variety protected in Poland is granted a CPVO title, the title granted in Poland is suspended for the period during which the breeder has the CPVO title.

*4. Impact of Plant Variety Protection*

(a) Overall Trends of Varieties Available in the Country

*(i) Number of Varieties*

Table 21 shows the development of the Polish PVP system in terms of the number of applications, titles granted and titles in force.

Table 21: PVP statistics in Poland

| | Applications filed by: | | | Titles issued to: | | | Titles having ceased to be in force in reference year | Titles in force at end of reference year |
|---|---|---|---|---|---|---|---|---|
| Year | Residents | Non-residents | Total | Residents | Non-residents | Total | | |
| 1988 | 64 | 6 | 70 | 7 | 0 | 7 | 0 | 7 |
| 1989 | 62 | 34 | 96 | 36 | 11 | 47 | 0 | 54 |
| 1990 | 53 | 127 | 180 | 18 | 0 | 18 | 2 | 70 |
| 1991 | 112 | 163 | 275 | 35 | 37 | 72 | 1 | 141 |
| 1992 | 55 | 152 | 207 | 25 | 102 | 127 | 16 | 252 |
| 1993 | 94 | 122 | 216 | 63 | 124 | 187 | 18 | 421 |
| 1994 | 112 | 166 | 278 | 64 | 89 | 153 | 44 | 530 |
| 1995 | 99 | 177 | 276 | 83 | 115 | 198 | 53 | 675 |
| 1996 | 96 | 176 | 272 | 53 | 46 | 99 | 142 | 632 |
| 1997 | 105 | 211 | 316 | 39 | 96 | 135 | 94 | 673 |
| 1998 | 78 | 305 | 383 | 81 | 222 | 303 | 33 | 943 |
| 1999 | 111 | 233 | 344 | 85 | 134 | 219 | 85 | 1,077 |
| 2000 | 100 | 219 | 319 | 91 | 295 | 386 | 72 | 1,391 |
| 2001 | 204 | 311 | 515 | 91 | 232 | 323 | 88 | 1,626 |
| 2002 | 136 | 317 | 453 | 97 | 167 | 264 | 58 | 1,832 |
| 2003 | 171 | 171 | 342 | 100 | 366 | 466 | 176 | 2,122 |

Figure 37 shows that the number of applications for protection continued to increase after the introduction of PVP. UPOV membership was followed by an increase in the number of applications from non-resident breeders. Figure 38 shows a clear increase in the number of titles in force in Poland, which indicates the increase in the number of varieties available for Polish farmers. The accession of Poland to the European Union in May 2004 resulted in a decrease in the number of applications for the Polish national PVP system. The decrease already began in 2002 as many breeders were aware that protection titles granted under the CPVO system would be extended to cover Polish territory on Poland's accession to the European Union.

Figure 37: Poland: Number of Applications

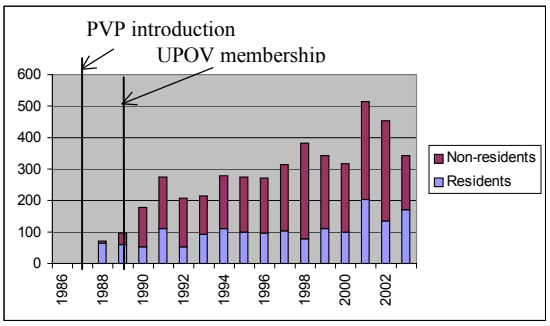
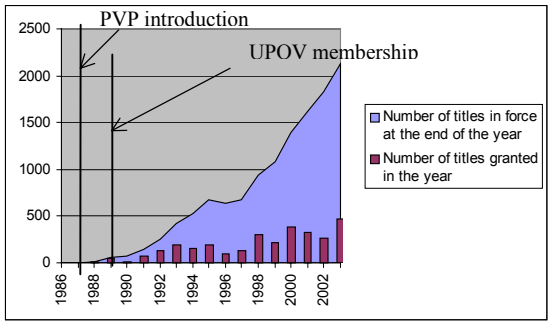



Figure 38: Poland: Development of the Number of PVP Titles Granted



As shown in Table 22, a number of new varieties of important agricultural crops such as potato, barley and maize have been granted protection through the PVP system in Poland. The PVP system has also been used extensively for the introduction of new varieties of ornamental species such as gerbera, rose, chrysanthemum, zonal pelargonium and lily.

Table 22: Poland: Number of titles granted by crop and year (top 10 crops)

| | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 |
|---|---|---|---|---|---|---|---|---|
| 1 | Potato (4) | Gerbera (15) | Gerbera (3) | Gerbera(16) | Carnation (33) | Gerbera (61) | Gerbera (32) | Gerbera (50) |
| 2 | Cucumber, Gherkin (2) | Triticale (4) | Tomato (3) | Carnation (9) | Gerbera (27) | Potato (26) | Carnation (16) | Rose (40) |
| 3 | Carnation (1) | Maize (3) | Celeriac (2) | Cucumber, Gherkin (4) | Zonal Pelargonium (15) | Cucumber, Gherkin (24) | Lily (16) | Potato (18) |
| 4 | | Field Bean (2) | Opium Poppy (2) | Barley (4) | Rose (9) | Carnation (17) | Potato (14) | Carnation (14) |
| 5 | | Barley (2) | Field Pea (2) | Potato (3) | Potato (6) | Rose (13) | Zonal Pelargonium (9) | Lily (8) |
| 6 | | Oats (2) | Dwarf French Bean (1) | Wheat (3) | Alstroemeria (5) | Alstroemeria (12) | Bedding Begonia (7) | Wheat (7) |
| 7 | | Head Lettuce (2) | Alstroemeria (1) | Maize (3) | Field Pea (4) | Ivy-leaved Pelargonium (7) | Cucumber, Gherkin (6) | Apple (6) |
| 8 | | Sugar Beet (1) | Barley (1) | Field Pea (3) | Wheat (4) | Streptocarpus (5) | Alstroemeria (5) | Hop (4) |
| 9 | | Marrow (1) | Wrinkled Pea/Round Pea (1) | Marrow (3) | Triticale (3) | Wheat (3) | Field Pea (5) | Tomato (4) |
| 10 | | Field Pea (1) | Potato (1) | Triticale (2) | Maize (3) | Maize (2) | Wheat (4) | Head Lettuce (4) |

Table 22: Cont.

| | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 |
|---|---|---|---|---|---|---|---|---|
| 1 | Lily (14) | Rose (39) | Rose (51) | Rose (35) | Chrysanthemum (65) | Rose (57) | Chrysanthemum (40) | Chrysanthemum (65) |
| 2 | Oilseed Rape (12) | Zonal Pelargonium (23) | Gerbera (38) | Gerbera (31) | Rose (43) | Chrysanthemum (44) | Rose (32) | Gerbera (47) |
| 3 | Tomato (11) | Chrysanthemum (13) | New Guinea Impatiens (25) | Potato (23) | Zonal Pelargonium (42) | Gerbera (44) | Potato (16) | Rose (36) |
| 4 | Cucumber, Gherkin (7) | Potato (8) | Ivy-leaved Pelargonium (18) | Barley (9) | Gerbera (38) | Lily (21) | Oilseed Rape (13) | New Guinea Impatiens (25) |
| 5 | Ivy-leaved Pelargonium (6) | Strawberry (6) | Zonal Pelargonium (16) | Busy Lizzie (8) | New Guinea Impatiens (35) | Wheat (14) | Gerbera (12) | Zonal Pelargonium (23) |
| 6 | Pepper (5) | Field Pea (6) | Petunia (16) | Apple (7) | Ivy-leaved Pelargonium (17) | Zonal Pelargonium (11) | Petunia (10) | Common Garden Verbena (16) |
| 7 | Marrow (4) | Cucumber, Gherkin (5) | Potato (16) | Oilseed Rape (7) | Lily (14) | Barley (8) | Zonal Pelargonium (9) | Potato (16) |
| 8 | Plum (3) | Wheat (5) | Poinsettia (15) | Chrysanthemum (6) | Field Pea (13) | Common Garden Verbena (8) | Cucumber, Gherkin (8) | Alstroemeria (13) |
| 9 | Carrot (3) | Maize (4) | Maize (9) | Wheat (6) | Elatior Begonia (11) | Potato (7) | Heather (7) | Barley (12) |
| 10 | Barley (3) | Oilseed Rape (3) | Pepper (8) | Common Garden Verbena (6) | Potato (11) | Ivy-leaved Pelargonium (7) | Strawberry (6) | Apple (11) |

Poland operates a national register (National List), which is an official list comprising the varieties of agricultural, vegetable and fruit plant species whose seed material can be legally produced and marketed in Poland. It should be noted that, for agricultural crops, one of the

requirements, in order for a variety to be included in the National List, is that it must demonstrate that it has value for cultivation and use (VCU). The VCU requirement means that a variety must possess characteristics and properties which effect improvement in cultivation or in utilization of the harvest or its products in comparison to the existing listed varieties. In other words all varieties must demonstrate that they are improved varieties in order to be listed. (Illustrative examples of the improvements offered by new, protected varieties are provided later in this Chapter: see part (ii) "Improvement of varieties".

The number of varieties filed on the National List and the number of varieties granted plant variety protection demonstrates that there has been an increasing availability of varieties since the introduction of PVP and accession to UPOV, although there are differences between crops.

Figure 39 indicates that the number of protected potato varieties has increased continuously since the introduction of the PVP system. The same graph shows also that the number of potato varieties listed in the National List has increased. This implies that a considerable number of new protected varieties were added to the National List, indicating the high quality of the new, protected varieties able to fulfil the requirements for the national listing (see also "The Case of Potato").

Figure 40 shows that similar trends were found in barley.

In contrast to the situation in potato and barley, where the availability of PVP was linked to the development of new varieties, the situation in tomato is somewhat different. Figure 41 shows that tomato breeders were not dependent on PVP titles of protection to develop new varieties. Most tomato varieties are hybrid varieties, meaning that the varieties cannot be reproduced without the hybrids' parent lines, which can be kept under the exclusive control of the breeder. In such cases, the breeder has less need of PVP to ensure he obtains the necessary recompense, particularly if there is rapid development of new varieties, although in some cases breeders still choose to seek protection on their hybrids and parent lines.

As shown in Figure 42, Poland's accession to UPOV in 1989 was associated with a clear response in respect of foreign gerbera varieties, which was later followed by an increase in the number of domestic protected varieties.

As shown in Figure 43, since becoming a member of UPOV, the number of protected rose varieties in Poland has continued to rise. Almost all of them are foreign entities.

Figure 39: Poland: Number of Listed and Protected Potato Varieties

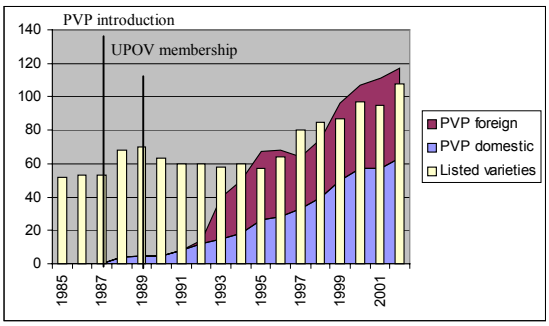



Figure 40: Poland: Number of Listed and Protected Barley Varieties

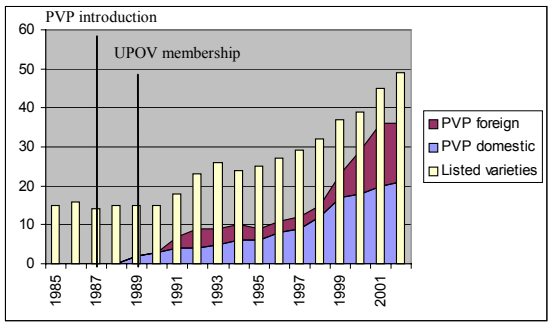


Figure 41: Poland: Number of Listed and Protected Tomato Varieties

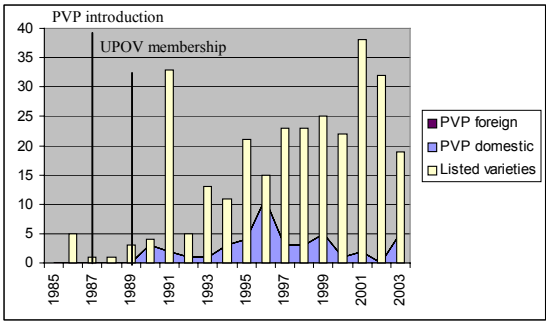



Figure 42: Poland: Number of Protected Gerbera Varieties

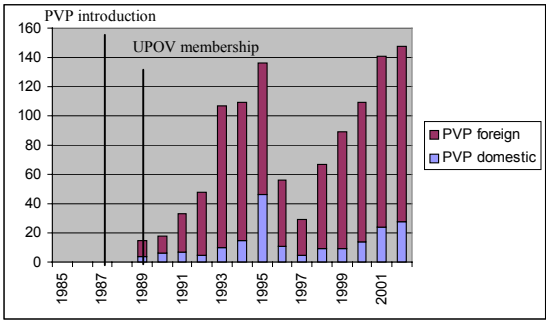
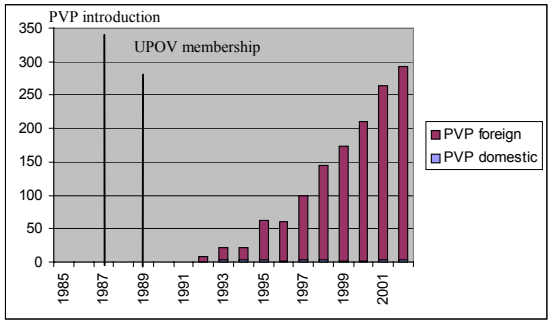



Figure 43: Poland: Number of Protected Rose Varieties




*(ii) Improvement of Varieties*

The Case of Gerbera (1985-2002)

Commercial cultivation of gerbera started in the 1960s in Poland. The breeding of gerbera was initiated during the period 1963-1965 at the University of Agriculture in Poznań. The "Polish race" of gerbera was created. The first four varieties were included in the National List in 1982 and since then new varieties have been introduced every year. Most of these were based on Polish genetic resources. Between 1985 to 2002, a rapid increase in the number of varieties available on the domestic market was observed, due to the importance of gerbera in floriculture. In 1987, applications for PVP were filed for the first foreign varieties. Since 1989, the year of Poland's accession to the UPOV Convention, both Polish and foreign protected varieties have been available on the domestic market. The proportion of gerbera planting material protected by PVP has steadily increased and now 100% of the varieties found in commerce are protected. The evolution of varieties has been accelerated in response of the fast changing market demand. The gerbera breeding industry in Poland has become more dynamic and competitive. PVP played a significant role in this process (See Box 21).

The Case of Potato (1985-2002)

The number of potato varieties registered in the National List has doubled during the period between 1985 and 2002 (see Figure 39), in particular the number of varieties with a short vegetation period. The number of protected varieties has systematically increased. The number of breeding and seed potato production companies, of which many are foreign

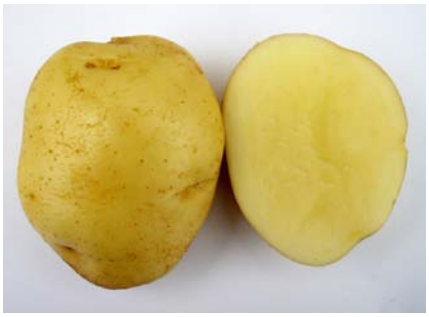
companies, has also increased. New types of varieties have been introduced which are suitable for processing (e.g. for potato chips). Agronomic characteristics of potato varieties have been improved; for example, introduction of resistance to viruses and to potato-root eelworm. In addition, varieties with improved culinary quality have been developed. As a result, a wider range of varieties has become available to farmers and consumers to meet their needs. Furthermore, a new type of potato variety has been introduced, which has a high starch content (over 20%) and a very high yield of starch (over 100 dt/ha) (See Box 22).

Box 21

Mr. Pętoś is one of the most important gerbera breeders in Poland. He works together with the Posnań Agriculture University. Varieties bred by him are based mainly on domestic genetic resources and are protected. Mr. Pętoś is the owner of 52 gerbera varieties (41 standard types and 11 mini gerbera varieties) (September 2005).

Box 22

The protected potato varieties "Ikar" and "Hinga" are examples of new, medium-late varieties with high starch content ("Ikar" with 22.2 % and "Hinga" with 22.1%). The average starch content of conventional medium-late starch varieties is 19.8% and the average of medium-late table varieties is 15.3%). The picture below shows tubers of "Hinga".



The Case of Tomato (1985-2002)

A large increase in the number of tomato varieties registered in the National List (in particular varieties grown in glasshouses) was recorded during the period between 1985 and 2005. A significant increase in the number of breeders (mainly foreign breeders) has also been observed. The share of hybrid varieties has increased substantially in recent years (especially indoor-growing varieties). Non-hybrid varieties are also used for outdoor cultivation. New types of varieties have been introduced, for example: varieties for growing on rockwool, varieties developed for processing; varieties with long shelf-life; cherry-type varieties. Improvement can be seen in increased resistance to important diseases; higher yield; better fruit quality; faster maturity; and tolerance to abiotic stresses. Users now have access to a wider range of tomato varieties (See Box 23 and Box 24). As explained earlier, breeders can use the protection inherent in hybrid varieties as an effective form of protection in some circumstances, or may choose to protect only the parent lines rather than all the hybrid varieties. However, in certain cases breeders also decide to protect hybrid varieties, including those cases where it is necessary to facilitate the conclusion of a commercial agreement.

Box 23

Julia: newly bred tomato hybrid variety, which shows a strong resistance to basic diseases (TmC5VFFr) and has a high fruit quality. It is also suitable to new production systems. Due to its advantages, "Julia" is protected in Poland and is becoming more and more popular for indoor cultivation in Poland.

Box 24

Alka: a newly bred tomato variety with a very early maturity. "Alka" is protected and can be sown directly in the field (varieties for outdoor cultivation), making it suitable for simplified production, without loss of market value of the product.

(b) Foreign investment / International Dimension

*(i) Introduction of Foreign Varieties*

Table 23 indicates that the PVP system has been linked to the introduction of new varieties of ornamental plants, such as chrysanthemum, rose, gerbera, New Guinea impatiens and lily, developed by foreign breeders. New varieties of main agricultural crops, such as barley, potato and wheat have also been made available by foreign breeders.

Table 23: Poland: Number of applications by non-residents by crops (top 10 crops)

| | 1999 | | 2000 | | 2001 | | 2002 | | 2003 | |
|---|---|---|---|---|---|---|---|---|---|---|
| Order | Crops | No | Crops | No | Crops | No | Crops | No | Crops | No |
| 1 | Chrysanthemum | 58 | Chrysanthemum | 45 | Rose | 45 | Chrysanthemum | 69 | New Guinea Impatiens | 25 |
| 2 | Gerbera | 36 | Rose | 45 | Chrysanthemum | 40 | Zonal Pelargonium | 39 | Chrysanthemum | 22 |
| 3 | Rose | 34 | Potato | 19 | Gerbera | 39 | Rose | 20 | Rose | 19 |
| 4 | Lily | 21 | Zonal Pelargonium | 15 | New Guinea Impatiens | 26 | Maize | 17 | Oilseed Rape | 13 |
| 5 | Potato | 9 | Black Currant | 9 | Potato | 12 | Lily | 13 | Anthurium | 9 |
| 6 | Common Garden Verbena | 7 | Ivy-leaved Pelargonium | 7 | Zonal Pelargonium | 11 | Common Garden Verbena | 13 | Wheat | 9 |
| 7 | Oilseed Rape | 7 | Strawberry | 7 | Petunia | 10 | Ivy-leaved Pelargonium | 12 | Barley | 8 |
| 8 | Strawberry | 6 | Common Garden Verbena | 7 | Common Garden Verbena | 9 | Gerbera | 8 | Potato | 6 |
| 9 | Wheat | 5 | Heather | 7 | Ivy-leaved Pelargonium | 6 | Barley | 8 | Poinsettia | 6 |
| 10 | Barley | 5 | Barley | 6 | Elatior Begonia | 5 | Busy Lizzie | 8 | Zonal Pelargonium | 6 |
| Total of the 10 | | 188 | | 167 | | 203 | | 207 | | 123 |
| Total applications by non-residents | | 233 | | 219 | | 311 | | 317 | | 171 |

(c) Domestic Breeding

*(i) Number of Varieties*

Table 24 shows that Polish breeders are predominant in the introduction of new varieties of main agricultural crops. In the ornamental sector, Polish breeders are also active in gerbera breeding.

Table 24: Poland: Number of applications by residents by crop (top 10 crops)

| | 1999 | | 2000 | | 2001 | | 2002 | | 2003 | |
|---|---|---|---|---|---|---|---|---|---|---|
| Order | Crops | No | Crops | No | Crops | No | Crops | No | Crops | No |
| 1 | Gerbera | 11 | Gerbera | 10 | Wheat | 17 | Wheat | 17 | Gerbera | 15 |
| 2 | Potato | 11 | Field Pea | 10 | Alstroemeria | 13 | Gerbera | 10 | Wheat | 14 |
| 3 | Tobacco | 8 | Potato | 7 | Onion | 13 | Potato | 9 | Triticale | 10 |
| 4 | Rye | 7 | Wheat | 6 | Gerbera | 11 | Barley | 8 | Carrot | 8 |
| 5 | Apple | 6 | Apple | 5 | Cucumber, Gherkin | 11 | Red Fescue | 6 | Dwarf French Bean | 8 |
| 6 | Wheat | 5 | Tobacco | 5 | Triticale | 11 | Oats | 5 | Oilseed Rape | 7 |
| 7 | Oats | 4 | Triticale | 4 | Barley | 9 | Triticale | 5 | Oats | 6 |
| 8 | Maize | 4 | Oats | 4 | Dwarf French Bean | 8 | Oilseed Rape | 5 | Barley | 6 |
| 9 | Barley | 4 | Cucumber, Gherkin | 4 | Rye | 8 | Sour Cherry | 5 | Potato | 5 |
| 10 | Red Fescue | 4 | Red Fescue | 4 | Apple | 7 | Rye | 4 | Tomato | 5 |
| Total of the 10 | | 64 | | 59 | | 108 | | 74 | | 84 |
| Total applications by residents | | 111 | | 100 | | 204 | | 136 | | 171 |

*(ii) Number of Breeders / Investment in Breeding*

For potato (Figure 44), the number of governmental breeding entities has declined since 1990 and particularly in the period 1994-2004. At the same time, the number of commercial companies, which are primarily foreign, increased during the period 1995-1997. This has not fully compensated in terms of number of breeding entities for the decline in governmental institutions since 1997. However, as is shown in Figure 39, fewer breeding entities have been able to provide more, improved potato varieties with many new and important characteristics.

As shown in Figure 45, the total number of breeding entities for tomato has shown a steady increase since 1990, again due to the increasing presence in Poland of foreign breeding companies. The number of Government institutions seems to have stabilized at a slightly lower level.

Figure 44: Poland: Number of potato breeding entities

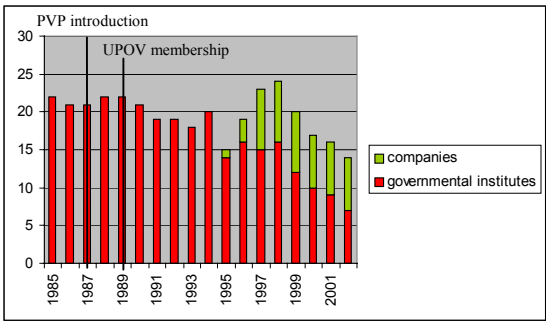
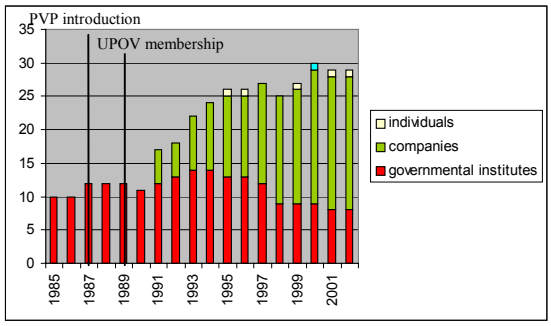



Figure 45: Poland: Number of Tomato breeding entities




As shown in Figure 46, the number of gerbera breeding entities has fluctuated considerably. A general increase in the number of breeding entities accompanied the introduction of PVP. The governmental institutions have slowly disappeared from the market because, since the 1990s, there has been no state funding for ornamental plant breeding. Some government institutions have been privatized. However, in the same way as seen in potato breeding, the number of gerbera varieties available for growers is greater than in the past (see Figure 42) and continues to grow. Thus, the net effect following the introduction of PVP has been, despite withdrawal of all public-funded breeding, an increase in the number of available varieties with improved qualities.

Figure 46: Poland: Number of Gerbera breeding entities

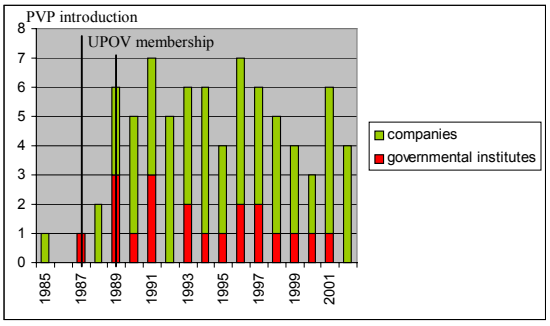
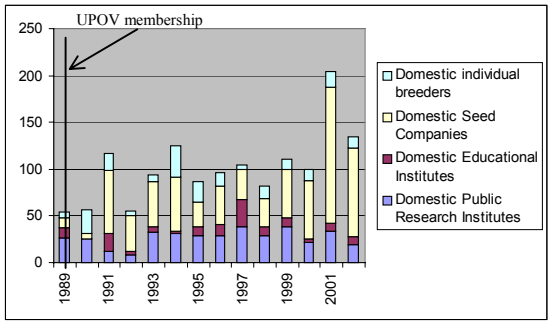



Figure 47: Poland: Number of Applications by Residents (Categories of Applicants) (1989 to 2002)



*(iii) Structure of the Breeding Industry*

As shown in Figure 47, the introduction of PVP in Poland and Poland's accession to UPOV offered an incentive for various categories of breeders, but especially for private seed companies, to release their varieties.

(d) Summary

The introduction of the PVP system in Poland in 1987 and its development coincided with the reform from a planned-economy to a market economy. Various industrial sectors, including agriculture and the seed industry, underwent a process of privatization and decentralization. Poland also suffered from hyperinflation during this period. All these factors make a precise analysis of the impact of the introduction of PVP in Poland difficult, especially where the methodology involves the comparison of data from before and after the introduction of the PVP system.

Nevertheless, from the data collected under this study, the following phenomena can be considered as a consequence of the introduction of PVP in Poland:

- the number of applications for protection has continued to increase after the introduction of PVP. UPOV membership was followed by an increase in the number of applications from non-resident breeders;

- the number of varieties filed on the National List (which must satisfy the requirement to demonstrate value for cultivation and use (VCU)) and the number of varieties granted plant variety protection demonstrate that there has been an increasing availability of improved varieties since the introduction of PVP;

- breeders have utilized the PVP system in major agricultural, horticultural and ornamental crops where it is important to support their breeding activities. PVP has not been used to protect all new varieties where protection is effected by biological means e.g. hybrids in tomatoes, although, even in such cases, breeders have also decided to protect hybrid varieties where it is necessary to facilitate the conclusion of a commercial agreement;

- improved characteristics of varieties of certain crops important for Polish agriculture and horticulture, including gerbera, potato and tomato;

- increased access to foreign varieties/germplasm, especially in the ornamental sector such as gerbera, rose etc.;

- increased number of commercial breeding entities and increased number of improved varieties despite a reduction in state-funded breeding;

- the accession of Poland to the European Union in May 2004 resulted in a decrease in the number of applications for the Polish national PVP system, which already began in 2002, as breeders responded to the fact that protection titles granted under the CPVO system extend to all members of the European Union.

# REPUBLIC OF KOREA

*1. General View of Agriculture in the Country*

Approximately 70% of the Republic of Korea is covered by mountains. Only 15% of the land area is covered by plains, which are mostly located along the coast. 19.1% of the land is used for agriculture, while 64.7% is used for forestry (2001). The Republic of Korea has a temperate climate with four distinct seasons and traits of oceanic climate as well. Average annual precipitation varies from 1,016 mm to 1,524 mm.

As a result of the rapid economic development of the country, the workforce active in the agricultural sector dropped from 50% in the 1940-50's to 4.6% in 2000. The average farm size is now around 1.48 ha.

The Republic of Korea is a pure importer of staple crops. Rice, which is the most important staple crop, is the only exception where the domestic consumption can be covered by the national production. In the case of other staple crops, such as maize and wheat, production has decreased drastically and now self-sufficiency rates are extremely low (0.1% for wheat, 1.2 % for maize). The production of barley and soybean is also decreasing; however, because of certain features of the national products favored by Korean consumers, a certain level of national production of these crops is maintained.

Vegetable production is the most important sector in Korean agriculture with an annual production of 10,062,423 tons in comparison with rice (5,000,149 tons) and fruits (2,411,305 tons) in 2004. It covers the national demand, and some competitive crops, such as sweet pepper, strawberry and tomatoes, are also exported The most important vegetables include Chinese cabbage, cucumber, garlic, hot pepper, melon and onion. Traditional vegetables such as perilla, oriental melon and sesame also remain important.

Among fruit crops, satsuma mandarin is the most important together with deciduous fruits such as apple, grapes, pears and persimmon. Flower production has recently increased to respond to the increased demand for ornamental plants by domestic consumers. The Korean export flower business is expanding rapidly.

*2. Short Description of the Seed Industry*

In the Republic of Korea, breeding and seed supply of traditional main crops, such as barley, rice, wheat and soybean, have been mainly conducted by the public sector. Almost all the necessary seed required has been produced domestically.

Conversely, private breeders have been the main players in the vegetable breeding sector. Chinese cabbage, onion, oriental melon, pepper, radish and watermelon are the most important seed-propagated vegetable species and breeding efforts are concentrated on these crops. Since 1997, some of the largest domestic seed companies have merged with foreign seed companies. It is also important to note that a considerable amount of seed for national vegetable production is produced abroad and shipped into the country. That is due to the unfavorable conditions for vegetable seed production, including climate, high costs etc., which exist in the Republic of Korea.

*3. Plant Variety Protection System*

The Republic of Korea introduced a system of PVP in 1997, in accordance with the provisions of the 1991 Act of the UPOV Convention and became a member of UPOV on January 7, 2002. PVP in the Republic of Korea is based on the Seed Industry Law of December 6, 1995, as revised on December 11, 2003. The National Seed Management Office (NSMO) of the Ministry of Agriculture and Forestry is responsible for the implementation of PVP. Protection has gradually been extended and as of December 1, 2004, 155 genera and species were eligible for protection. Table 25 below shows the chronological extension of protection in the Republic of Korea. It is anticipated that protection will be extended to all plant genera and species by 2009.

Table 25: Republic of Korea: Genera and species eligible for protection

| Genera and species | Eligible for protection since: |
|---|---|
| Rice, Barley, Soybean, Maize, Potato, Wheat, Radish, Chinese cabbage, Cabbage, Pepper, Tomato, Cucumber, Oriental melon, Water melon, Squash, Welsh onion, Onion, Carrot, Lettuce, Spinach, Plain cactus, Apple, Pear, Peach, Rye grass, Tall fescue, Red clover | December 31, 1997 (27 genera/species) |
| Oats, Sweet potato, Sesame, Perilla, Groundnut, Rape, Melon, Broccoli, Cauliflower, Grapevine, Yuzu (Citrus), *Forsythia*, *Hibiscus*, *Lycoris*, *Ajuga multiflora*, *Lisianthus*, *Petunia*, *Godetia*, *Impatiens*, *Cyclamen*, Snapdragon, Pansy, Daisy, Alstroemeria, Hyacinth, *Angelica gigas*, *Astragalus membranaceus*, *Ginseng*, *Pleurotus*, Orchardgrass | May 1, 2000 (30 genera/species) |
| *Dendrobium*, *Aerides japonicum*, *Neofinettia falcata*, *Calanthe discolor*, Rose, Lily, Chrysanthemum, *Iris*, *Gladiolus*, Tulip, Poinsettia, *Celosia*, Stock, *Zinnia*, *Myosotis alpestris*, *Senecio cruentus*, *Nasturtium*, Pot marigold, *Lobularia maritama*, Ageratum, Hemerocallis, Rehmannia glutinosa, *Lycium, Dioscorea*, *Bupleurum falcatum*, *Platycodon grandiflorum*, *Cassia*, *Cnidium*, *Liriope platyphylla*, *Anglic dahurica*, *Saposhnikovia* | July 1, 2001 (31 genera/species) |
| Rye, Adzuki bean, Mungbean, Pea, Egg plant, Pakchoi, Gourd, *Sterelitzia*, *Cattleya*, *Oncidium*, *Hosta*, *Campanula*, *Pelargonium*, *Paeonia suffruticosa*, *Kalanchoe*, *Chamaecereus*, *Ganoderma*, *Angelica*, *Pleuropterus*, *Alisma*, *Scutellaria*, *Paeonia lactiflora*, *Carthamus*, *Codonopsis*, Kiwi fruit | July 1, 2002 (25 genera/species) |
| Kidney bean, Job's tears, Mustard, Turnip rape, Kohlrabi, Edible chrysanthemum, Dahlia, *Allium*, Imperial fritillary, *Gloxinia*, Common calla, Blue grape hyacinth, *Ornithogalum*, *Anthrium*, Crocus, *Amaryllis*, Royal azalea, Common camellia, *Hydrangea*, Carnation, Gerbera, Gypsophila, Kaffir lily, Sea lavendar, Begonia, Bachelor's button, Moth-orchid, *Aquilegia*, *Campanula*, (*Campanula punctata* Lamarck), *Campanula* (*Campanula takesimana* Nakai), Rough gentian, *Gentiana*, Aster, Spring orchid, Winter orchid, Chinese pink, Freesia, Schizandra, *Angelica*, *Atractylis*, *Cnidium*, *Phellinus* | December 1, 2004 (42 genera/species) |

## 4. *Impact of Plant Variety Protection*

### (a) Overall Trends of Varieties Available in the Country

#### *(i) Number of Varieties*

As shown in Figure 48, the Republic of Korea recorded a high number of PVP applications by domestic residents immediately after the introduction of PVP in 1997. The second peak in the number of applications was recorded in 2002, the year in which the Republic of Korea acceded to the UPOV Convention.

As shown in Figure 49, the number of applications for PVP in vegetables has increased steadily since the introduction of PVP in 1997. There was a large response in 2002, the year in which the Republic of Korea acceded to the UPOV Convention, in terms of PVP applications for varieties of ornamental species. Important ornamental species such as chrysanthemum, lily and rose first became eligible for protection in July 2001. The number of applications for PVP in agricultural species had peaks in 1998 and 2001.

As shown in Figure 50, the first PVP title was granted in 2000. Since then the number of titles in force has increased continuously.

Figure 48: Republic of Korea: Number of Applications

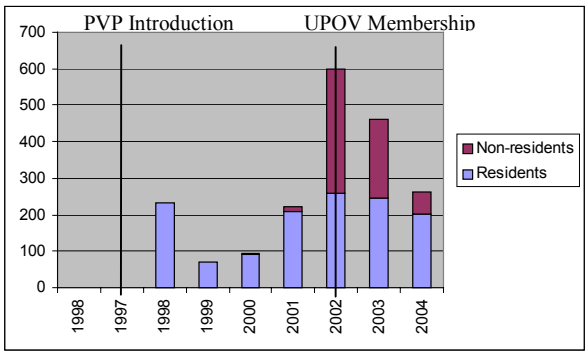



Figure 49: Republic of Korea: Number of Applications by Categories of Crops

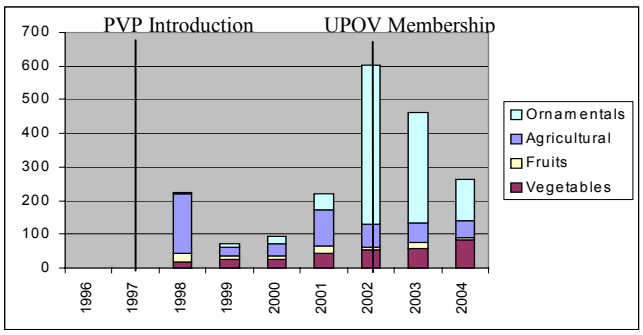
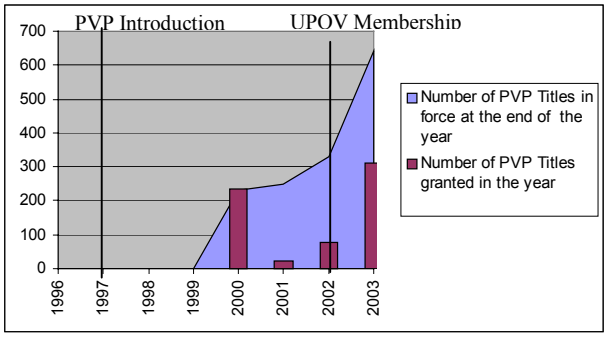



Figure 50: Republic of Korea: Development of the Number of PVP Titles Granted

PVP Introduction




As shown in Table 26, farmers in the Republic of Korea have seen the development of a number of new, protected varieties of important agricultural crops such as rice, soybean and barley. The vegetable sector has also benefited through the development of new, protected

varieties of Chinese cabbage, pepper, etc. After protection was extended to ornamental crops and the Republic of Korea became a member of UPOV, a large number of varieties of rose, chrysanthemum and other ornamental species received protection. It should be noted that the PVP system is also used for new varieties of traditional crops such as, perilla, sesame, oriental melon and ginseng (see Box 25).

Table 26: Republic of Korea: Number of titles granted from 2000 to 2004 (top 10 crops)

| | 2000 | | 2001 | | 2002 | | 2003 | | 2004 | |
|---|---|---|---|---|---|---|---|---|---|---|
| Order | Crops | No | Crops | No | Crops | No | Crops | No | Crops | No |
| 1 | Rice | 91 | Oriental melon | 5 | Rice | 22 | Rose | 80 | Rose | 194 |
| 2 | Soybean | 42 | Radish | 4 | Soybean | 10 | Sesame | 19 | Chrysanthemum | 100 |
| 3 | Barley | 39 | Chinese cabbage | 4 | Cactus | 9 | Perilla | 16 | Gymnocalyciu m mihanovichii | 26 |
| 4 | Maize | 16 | Pepper | 3 | Chinese cabbage | 8 | Peanut | 16 | Rice | 14 |
| 5 | Pear | 15 | Soybean | 2 | Potato | 6 | Poinsettia | 15 | Gladiolus | 11 |
| 6 | Wheat | 12 | Water melon | 2 | Barley | 5 | Cactus | 14 | Potato | 10 |
| 7 | Apple | 6 | Pumpkin | 1 | Radish | 5 | Chrysanthemum | 11 | Soybean | 8 |
| 8 | Peach | 5 | Lettuce | 1 | Maize | 4 | Impatiens | 11 | Barley | 7 |
| 9 | Potato | 3 | | | Ginseng | 2 | Rice | 10 | Pepper | 7 |
| 10 | Radish<br>Cucumber<br>Pumpkin<br>Italian ryegrass | 1<br>1<br>1<br>1 | | | Sweet potato<br>Pepper<br>Pumpkin<br>Apple<br>Pear | 1<br>1<br>1<br>1<br>1 | Peach | 10 | Petunia,<br>Perilla | 7<br>7 |
| Total of the 10 | | 233 | | 22 | | 76 | | 202 | | 391 |
| Total titles granted | | 233 | | 22 | | 76 | | 310 | | 477 |

| Box 25 | Box 26 |
| --- | --- |
| Perilla variety "Bora", developed in 2001 and granted protection in 2004, has high leaf yield for leaf vegetable and has purple color on the reverse side of the leaf  | The premium quality milled-rice variety “Ilpum”, protected in 2004, with translucent endosperm (left) and the conventional milled-rice “Yangjo”, protected in 2000, with some white belly (right)  |

*(ii) Improvement of Varieties*

Following the introduction of PVP new, improved varieties have been seen in various sectors of agricultural and horticultural production, for example:

Rice

Rice varieties with high-quality endosperm are demanded by consumers in the Republic of Korea. The endosperm of milled-rice in recently developed rice varieties has been significantly improved since the introduction of PVP (see Box 26)

Specialty rice “Goami 2”, which was protected in 2004, has high fiber content in the endosperm and was developed for special use as a hospital food for diabetics, a sweet rice drink, and for rice wine.

Three elite lines with superior total digestible nutrient and crude protein content have been bred for animal feed. These lines are being tested for their agronomic traits in local adaptability tests in the Republic of Korea.

Ginseng

Five new ginseng varieties have recently been bred and have received protection. Applications for protection of two further varieties have been filed. In ginseng, the percentage of high quality ginseng roots called “red ginseng” vis-à-vis the total amount of ginseng roots is one of the most important commercial characteristics. The newly developed varieties show a high level of “red ginseng” proportion (24 to 38%, in comparison to 15% for the average of conventional ginseng varieties) as well as a higher root yield (see Box 27).

Box 27

Root yield and red ginseng proportion of new ginseng varieties

| Varieties | Root yield (ton/ha) | Red ginseng percentage (%) |
|---|---|---|
| Chunpoong | 6.39 | 38.00 |
| Yunpoong | 7.35 | 20.60 |
| Geumpoong | 6.15 | 35.40 |
| Gopoong | 5.73 | 24.70 |
| Sunpoong | 5.70 | 23.90 |
| Average of conventional varieties | 5.46 | 15.00 |

High-quality variety "Chunpoong

Rose

Most varieties of rose which were introduced and marketed a few years ago were standard types. However, spray and pot type varieties have recently been added to the standard type varieties. The favored colors for rose flowers were red, white and pink, but they have been diversified to bi-colors, pastel (orange), green etc. (see Box 28)

Box 28
Diversification of rose varieties (spray type / pastel color)

Standard type

Spray type

Pastel (orange) color

(b) Foreign Investment / International Dimension

*(i) Introduction of Foreign Varieties*

Table 27 shows the development of the number of applications by non-residents. It indicates a strong interest by foreign breeders to introduce their varieties into the Republic of Korea. Most of the varieties introduced by foreign breeders are ornamentals and their introduction coincides with the accession of the Republic of Korea to UPOV and the emergence of the flower business in the Republic of Korea.

Table 27: Republic of Korea: Number of applications by non-residents by crops (top 10 crops)

| | 2000 | | 2001 | | 2002 | | 2003 | | 2004 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Crops | No | Crops | No | Crops | No | Crops | No | Crops | No |
| Order | | | | | | | | | | |
| 1 | Pepper | 1 | Impatiens | 11 | Rose | 246 | Rose | 61 | Rose | 29 |
| 2 | | | | | Chrysanthemum | 68 | Chrysanthemum | 55 | Chrysanthemum | 17 |
| 3 | | | | | Petunia | 17 | Kalanchoe | 36 | Petunia | 4 |
| 4 | | | | | Poinsettia | 11 | Impatiens | 31 | Impatiens | 3 |
| 5 | | | | | | | Petunia | 14 | Poinsettia | 2 |
| 6 | | | | | | | Pelargonium | 13 | Kalanchoe | 2 |
| 7 | | | | | | | Poinsettia | 3 | Apple | 2 |
| 8 | | | | | | | Kiwi fruit | 1 | Chinese Cabbage | 1 |
| 9 | | | | | | | | | | |
| 10 | | | | | | | | | | |
| Total of the 10 | | 1 | | 11 | | 342 | | 214 | | 60 |
| Total applications by non-residents | | 1 | | 11 | | 342 | | 214 | | 60 |

*(ii) Development of Foreign Markets*

As shown in Figure 51, the export of flowers and ornamental plants increased rapidly, but markedly so after 1998, coinciding with the introduction of PVP in 1997. Table 28 shows a rapid increase in the number of rose varieties marketed in the Republic of Korea market.

Figure 51: Republic of Korea: Export of flowers and ornamental plants (US$ 1000)

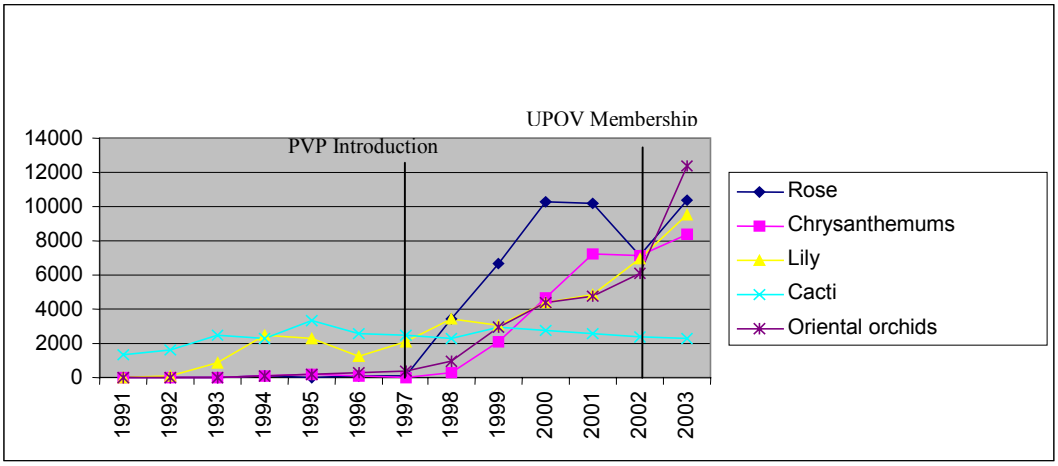



Table 28: Number of rose varieties marketed in the Republic of Korea

| Year | 2000 | 2001 | 2002 | 2003 | 2004 |
|---|---|---|---|---|---|
| Number of varieties | 139 | 180 | 209 | 274 | 309 |

*(iii) Breeder's Exemption*

The UPOV system of PVP allows the use of protected varieties for breeding other varieties under the principle of breeder's exemption. For example, the foreign rose varieties for which protection had been filed may be used by the Republic of Korean breeders for further breeding purposes. In the case of the Republic of Korea, the increased investment in rose breeding, implied through the increased number of rose breeders, and the increased rose germplasm resulting from the introduction of foreign rose varieties, would strengthen the rose breeding sector in the Republic of Korea (see Box 29).

Box 29

Korean rose variety "Red Angel", granted protection in 2003, was bred using the protected variety "Little Marble", developed in the Netherlands

Little Marble (Red colored variety)
Developed in the Netherlands

Red Angel (Dark red variety)
Developed at the Kyunggi Provincial Rural Development Administration
Crossing of: Princess×Little Marble

(c) Domestic Breeding

*(i) Number of Varieties*

Table 29 shows the number of applications for PVP filed by residents. It indicates that for important agricultural and vegetable crops, such as, rice, soybean, barley and Chinese cabbage etc., domestic breeders play a major role. Domestic breeders are also active in the breeding of traditional crops such as sesame, perilla, ginseng and oriental melon. As shown in Table 27, foreign breeders predominate in the breeding of ornamental crops. However, some applications for ornamental varieties, such as rose and chrysanthemum, originate both from domestic and foreign breeders.

For rice, there was an initial surge immediately following the introduction of PVP, accounted for by the large number of existing varieties, recently developed by government research stations. The PVP Law of the Republic of Korea, in conformity with Article 6(2) of the 1991 Act of the UPOV Convention (varieties of recent creation), enables such rice varieties to be protected.

Table 29: Republic of Korea: Number of applications by residents by crops (top 10 crops)

| | **1998** | | **1999** | | **2000** | |
|---|---|---|---|---|---|---|
| | Crops | No | Crops | No | Crops | No |
| Order | | | | | | |
| 1 | Rice | 78 | Rice | 13 | Cactus | 15 |
| 2 | Soybean | 37 | Radish | 10 | Rice | 14 |
| 3 | Barley | 35 | Cactus | 9 | Chinese Cabbage | 10 |
| 4 | Maize | 15 | Soybean | 7 | Pepper | 5 |
| 5 | Pear | 15 | Peach | 7 | Soybean | 5 |
| 6 | Wheat | 10 | Chinese Cabbage | 6 | Barley | 5 |
| 7 | Apple | 7 | Barley | 4 | Potato | 5 |
| 8 | Pepper | 6 | Oriental Melon | 3 | Ginseng | 5 |
| 9 | Radish | 5 | Wheat | 2 | Peach | 4 |
| 10 | Chinese Cabbage<br>Water- melon<br>Peach | 4<br><br>4<br>4 | Lettuce<br>Apple<br>Pear | 2<br>2<br>2 | Petunia | 4 |
| Total of the 10 | | 212 | | 67 | | 72 |
| Total applications by Residents | | 234 | | 72 | | 93 |
| | | | | | | |

Table 29: Cont.

| | 2001 | | 2002 | | 2003 | | 2004 | |
|---|---|---|---|---|---|---|---|---|
| | Crops | No | Crops | No | Crops | No | Crops | No |
| Order | | | | | | | | |
| 1 | Sesame | 25 | Rose | 28 | Rose | 27 | Pepper | 25 |
| 2 | Peanut | 20 | Chrysan-themum | 26 | Petunia | 22 | Rose | 19 |
| 3 | Rice | 18 | Lily | 25 | Pansy | 22 | Rice | 13 |
| 4 | Rose | 18 | Lycoris | 20 | Water- melon | 18 | Gymnocalycium mihanovichii | 12 |
| 5 | Perilla | 17 | Rice | 16 | Rice | 13 | Radish | 10 |
| 6 | Cactus | 14 | Potato | 15 | Cactus | 11 | Chinese Cabbage | 10 |
| 7 | Radish | 9 | Gladiolus | 14 | Chrysan-themum | 9 | Watermelon | 10 |
| 8 | Sweet Potato | 8 | Chinese Cabbage | 12 | Soybean | 8 | Chrysan-themum | 10 |
| 9 | Chinese Cabbage | 7 | Pepper | 11 | Pepper | 8 | Prairie Gentian | 10 |
| 10 | Pepper<br>Peach | 7<br>7 | Water melon | 9 | Peach | 8 | Tomato | 9 |
| Total of the 10 | | 150 | | 176 | | 146 | | 128 |
| Total applications by Residents | | 210 | | 260 | | 249 | | 202 |

*(ii) Number of Breeders/Investment in Breeding*

Although the number of breeders is relatively stable for most crops, there have been some crops for which a notable change has been observed.

As shown in Figure 52, a sharp increase in the number of rose breeders was observed in 1996. In that year, the number of companies increased from one to 13 and four "new" individual breeders also appeared.

Figure 53 shows a similar development in the rice breeding sector where the number of breeders has increased in various sectors such as private companies, universities and government research stations.

Figure 52: Republic of Korea: Number of Rose Breeders

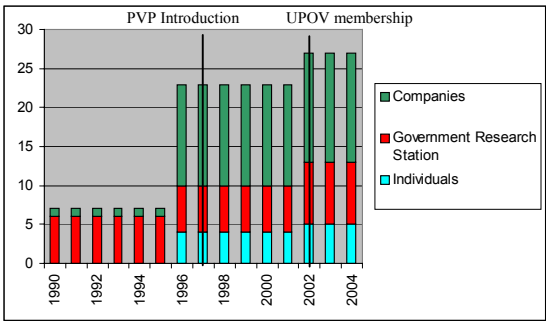
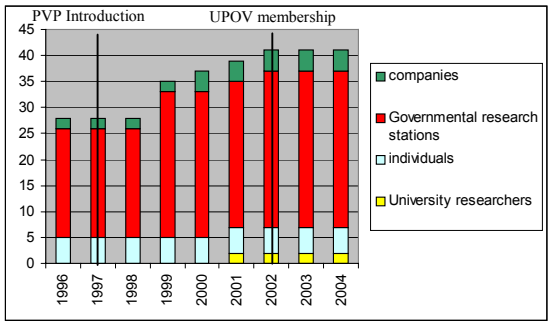



Figure 53: Republic of Korea: Number of Rice Breeders




The domestic breeding of rose was first started in the government research stations in 1990 and was later followed by private companies. As shown in Figure 54, investments by

rose-breeding companies have increased steadily since the introduction of PVP. Government research stations have also increased their investment, with a significant peak in 2000 reflecting substantial investment in infrastructure for rose breeding, such as new greenhouses and breeding fields.

As shown in Figure 55, investment by companies breeding Chinese cabbage increased considerably in 1999 and 2000, after the introduction of PVP. The much lower levels of investment of the government research stations have remained relatively stable.

Figure 54: Republic of Korea: Breeding Investment Rose

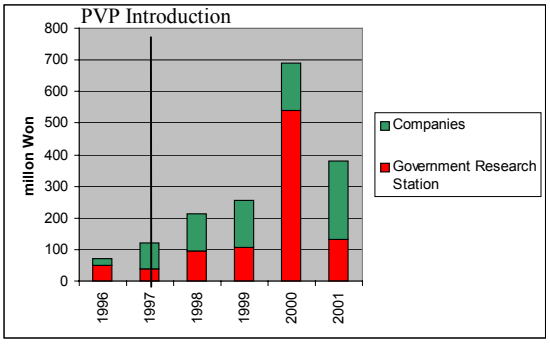
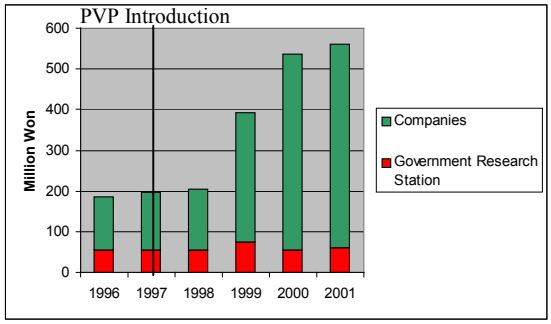


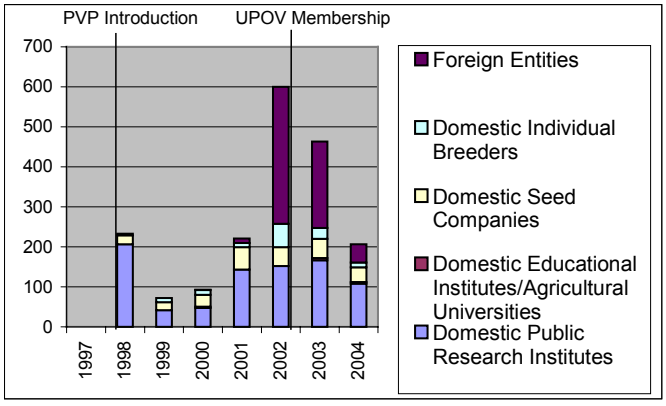

Figure 55: Republic of Korea: Breeding Investment Chinese Cabbage




### *(iii) Structure of the Breeding Industry*

Figure 56 shows the number of applications by categories of applicants between 1998 and 2003. Public research institutes, such as crop research institutes, horticultural research institutes and provincial crop stations, have made the most applications. Foreign entities made a large number of applications after 2002 in particular for ornamental species. Since the introduction of the PVP system in the Republic of Korea, many university researchers have become interested in breeding commercial varieties. Seed companies are developing new varieties focussing mostly on vegetable species. Domestic individual breeders (farmer breeders) show interest mainly in rice and fruit species.

Figure 56: Republic of Korea: Number of Applications by Categories of Applicants




Box 30

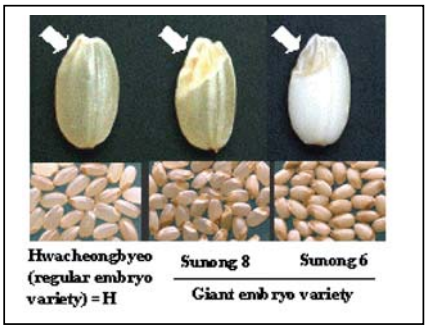
Keumsung: Rice variety developed by a domestic individual breeder and granted protection in 2002

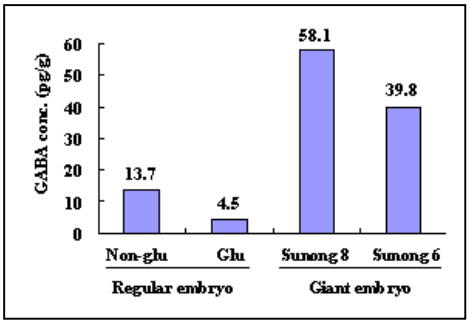
The introduction of PVP was accompanied by an increase in the number of rice breeders and the number of released rice varieties. Rice breeding was previously conducted by three governmental research institutions, namely the National Institute of Crop Science, Honam Agricultural Research Institute and Yeongnam Agricultural Research Institute. New players,

such as individual rice breeders (farmer breeders) (see Box 30) and university researchers appeared in the rice breeding sector. Further changes have been observed recently in the breeding objectives for rice in the Republic of Korea, namely, besides high productivity, new objectives such as high quality for cooking and processing, reliability for cultivation (e.g. direct seeding, resistance to stress etc.) and diversification of usage (e.g. diet food, healthy food, for feed etc.) have been added. The new structure of the rice breeding sector has become more responsive to such new demands from rice consumers (Box 31).

Box 31

Seoul National University has developed a series of new types of rice varieties. These varieties are protected or are under examination for protection. For example, varieties with a giant-embryo (Sunong 6 and 8) contain higher levels of various functional components such as oryzanol, phytosterol, tocopherol, and dietary fibers in comparison to varieties with a regular embryo, but in particular they show a high level of GABA (γ-amino butyric acid) concentration (See the graphics below).




Sunong 10 is characterized by its sugary-endosperm, containing less starch and, subsequently, more water soluble carbohydrates than regular grains. Sunong 9 and 12 are characterized by a floury endosperm (Sunong 9) and by a giant embryo and a floury endosperm (Sunong 12), respectively. These varieties are expected to provide a healthy rice diet through their functionality, to promote rice consumption and to contribute to high value-added rice production.

(d) Summary

The introduction of PVP in the Republic of Korea in 1997 and membership of the UPOV Convention in 2002 have had a significant influence on the seed and breeding industries. Although it is still premature to evaluate the full impact, the following effects have been observed:

- introduction of PVP resulted in a large number of PVP applications by residents. Membership of UPOV was associated with a large number of PVP applications by non-residents, particularly in the ornamental sector;

- instant response to the extension of the range of genera and species covered by PVP which was typically observed in the case of the extension of protection to ornamental crops in July 2001;

- new, improved varieties have been produced in a range of agricultural and horticultural crops, including in traditional crops (e.g. ginseng);

- introduction of new foreign varieties, especially varieties of ornamental crops such as rose, providing immediate benefits for the flower industry of the Republic of Korea, one of the fastest developing sectors of agriculture in the country; introduced varieties have been used by domestic breeders for further breeding;

- increase in the number of breeders of certain crops, such as rice and rose;

- stimulation of certain sectors of plant breeding; for example, in the rice breeding, new types of breeders such as individual rice breeders (farmer breeders) and university researchers, have appeared. Since the introduction of PVP there has been an important transformation in the rice breeding sector to meet the evolving demands for rice. In the sector of rose breeding, private breeders have appeared and the number of domestic varieties has increased.

# SECTION IV: CONCLUSION

In order to provide a meaningful study on the impact of PVP it is important to understand the purpose of such a system of intellectual property rights. UPOV clarifies that its mission is "To provide and promote an effective system of plant variety protection, with the aim of encouraging the development of new varieties of plants, for the benefit of society".

Thus, the UPOV system of PVP is designed to encourage innovation in the field of plant breeding. In that respect, the UPOV Convention recognizes that it is important to encourage breeding in all plant genera and species and not to pre-determine for which genera and species breeding would, or could, be beneficial. As explained in Section I (Introduction), the key to an effective PVP system is to provide incentives to breeders to develop new varieties and to avoid the absence of suitable protection being a barrier to the availability of those varieties.

It is apparent that the impact of PVP will vary country-by-country and crop-by-crop. Accordingly, although substantial benefits have been seen across the range of UPOV members and, in particular, in each of the countries in this study, the results and conclusions of the study need to seen in the context of the individual situations. On that basis, this chapter on conclusions starts by summarizing the impact of PVP at the country level, as reported in Section III, and then provides an overall review of the development of the UPOV system, as reported in Section II, as a basis for identifying some general trends in the impact of PVP.

## Impact of PVP at the National Level

### *Argentina*

In Argentina, a PVP system had been in place for a number of years before the system was amended in line with the 1978 Act of the UPOV Convention, with protection being offered to all plant genera and species. This situation allowed the impact of the UPOV system and UPOV membership to be considered in relation to a national, non-UPOV PVP system.

The impact of PVP in Argentina was characterized as follows:

- Argentina introduced a PVP system in 1973. However, creation of INASE and amendment of the PVP system to be in conformity with the 1978 Act of the UPOV Convention, except for certain aspects concerning foreign applications, was accompanied by a substantial increase in the number of titles granted to domestic breeders. In the 10-year period prior to those developments (1982-1991) the average annual number of titles granted to domestic breeders was 26, which more than doubled to 70 (267%) for the subsequent 10-year period (1992-2001);

- prior to 1994, Argentina provided protection to varieties bred by non-residents on a mutual reciprocity bases (i.e. where Argentinean breeders were able to protect varieties in those other countries), resulting in bilateral agreements in some cases. In 1994, the PVP system in Argentina became fully compatible with the 1978 Act of the UPOV Convention, including with respect to foreign applications, and Argentina acceded to the UPOV Convention. The number of titles granted to non-residents increased in conjunction with those developments. In the 10-year period prior to those developments

(1984-1993) the average annual number of titles granted to foreign breeders was 17, which more than trebled to 62 (355%) for the subsequent 10-year period (1994-2003);

- introduction of new, protected varieties from non-resident breeders can be seen in important agricultural crops (e.g. soybean, lucerne), where improved varieties are important for competitiveness in the global market; and in horticultural crops (rose, strawberry);

- increase in the number of domestic breeding entities seen, for example, in soybean and wheat, most of which occurred in the private sector;

- increase of horizontal cooperation in the seed industry, involving foreign seed companies and agreements for technology transfer between national research institutes and breeding entities with other national companies (Technological Relationships Agreements), resulting in more rapid movement of germplasm.

*China*

China introduced its PVP system, based on the 1978 Act of the UPOV Convention, in March 1997. The PVP system became operational in 1999 and China also became a member of UPOV in 1999. China has two separate PVP schemes, operated by the Ministry of Agriculture and the State Forestry Administration. The Ministry of Agriculture has gradually extended protection to 41 genera and species. The State Forestry Administration has gradually extended protection to 78 genera or species. Thus, China's PVP systems have only been in operation for 5 years and for a limited number of genera and species and it is not yet possible to evaluate their full impact. Nevertheless, the following effects have been observed:

- rapid uptake by farmers of new, protected varieties seen, for example, in maize and wheat in Henan Province: Farmers have decided to buy seed of protected varieties, the price of which includes royalties, in anticipation of a higher economic return from the use of better varieties;

- new, protected varieties have been introduced major staple crops (e.g. rice, maize, wheat), horticultural crops (e.g. rose, Chinese cabbage, pear), including traditional flowers (e.g. peony, magnolia, camellia) and for forest trees (e.g. poplar);

- start of an introduction of new, foreign varieties, in particular for ornamental varieties;

- stimulation of commercial breeding activities in domestic public research institutes and domestic seed companies, with an increase in the number of breeders (e.g. maize and wheat in Henan Province) linked to increased numbers of PVP applications;

- income generation for breeders, including public research institutions and agricultural universities, and encouragement of further investment in plant breeding.

Providing information and raising awareness of the PVP system for breeders, potential new breeders and users have been seen to be important measures for a rapid impact.

*Kenya*

In Kenya, the PVP scheme started to operate in 1997 and Kenya acceded to the 1978 Act of the UPOV Convention in 1999. Kenya grants plant breeders' rights for all plant genera and species other than algae and bacteria. The following impacts have been observed:

- significantly higher number of varieties developed and released in the six-year period after the introduction of PVP (1997-2003), compared to the previous six-year period (1990-1996), across a number of agricultural crops and for maize in particular;

- increased introduction of foreign varieties, especially in the horticultural sector, which contribute to the diversification of the horticultural sector (for example the emergence of the flower industry) and support the competitiveness of Kenyan products (cut flowers, vegetables and industrial crops) in global markets;

- increased introduction of foreign germplasm in the form of new, protected varieties (especially of horticultural crops) which has been used by Kenyan breeders for further breeding;

- increase of the number of Kenyan-bred varieties of agricultural crops with improved performance (e.g. yield, pest and disease tolerance, nutritional qualities, early maturity and tolerance to abiotic stresses) for local farmers including subsistence farmers. PVP titles for many Kenyan-bred varieties are in the hands of public institutions and local farmers can use the propagating material of the new, protected varieties under privileged conditions; for example, subsistence farmers have been permitted to exchange seed among themselves;

- facilitation of public / private partnerships for plant breeding, including partnership between international research institutes (CGIAR) and Kenyan seed companies, and emergence of new types of breeders (university researchers, private farmer-breeders).

*Poland*

A PVP system was introduced in 1987 and its development coincided with the reform of the Polish society from the planned-economy to the market economy. Various industrial sectors, including agriculture and the seed industry, underwent a process of privatization and decentralization. Poland also suffered from hyperinflation during this period. Poland became a member of UPOV in 1989. In 1990, a series of reforms to adjust the Polish seed scheme to a market economy were implemented. The PVP Law was amended according to the provisions of the 1991 Act of the UPOV Convention in 1995. Since 2003, Poland has been party to the 1991 Act of the UPOV Convention. Poland grants plant breeders' rights to all plant genera and species. Poland joined the European Community in May 2004 and since that time, protection of new varieties of plants can be granted either through the Polish national PVP system or through the European PVP system, which is operated by the Community Plant Variety Office (CPVO). A PVP title granted by the CPVO is valid in all 25 member States of the European Community. All these factors make a precise analysis of the impact of the introduction of PVP in Poland difficult. Nevertheless, from the data collected under this study, the following phenomena were considered to reflect the impact of the introduction of PVP in Poland:

- the number of applications for protection has continued to increase after the introduction of PVP. UPOV membership was followed by an increase in the number of applications from non-resident breeders;

- the number of varieties filed on the National List (which must satisfy the requirement to demonstrate value for cultivation and use (VCU)) and the number of varieties granted plant variety protection demonstrate that there has been an increasing availability of improved varieties since the introduction of PVP;

- breeders have utilized the PVP system in major agricultural, horticultural and ornamental crops where it is important to support their breeding activities. PVP has not been used to protect all new varieties where protection is effected by biological means e.g. hybrids in tomatoes, although, even in such cases, breeders have also decided to protect hybrid varieties where it is necessary to facilitate the conclusion of a commercial agreement;

- improved characteristics of varieties of certain crops important for Polish agriculture and horticulture, including gerbera, potato and tomato;

- increased access to foreign varieties/germplasm, especially in the ornamental sector such as gerbera, rose etc.;

- increased number of commercial breeding entities and increased number of improved varieties despite a reduction in state-funded breeding;

- the accession of Poland to the European Union in May 2004 resulted in a decrease in the number of applications for the Polish national PVP system, which already began in 2002, as breeders responded to the fact that protection titles granted under the CPVO system extend to all members of the European Union.

*Republic of Korea*

The Republic of Korea introduced a system of PVP in 1997 which conformed with the provisions of the 1991 Act of the UPOV Convention and became a member of UPOV in 2002. Protection has gradually been extended and in 2004, 155 genera and species were eligible for protection. Although it is still considered premature to evaluate the full impact, the following effects have been observed:

- introduction of PVP resulted in a large number of PVP applications by residents. Membership of UPOV was associated with a large number of PVP applications by non-residents, particularly in the ornamental sector;

- instant response to the extension of the range of genera and species covered by PVP which was typically observed in the case of the extension of protection to ornamental crops in July 2001;

- new, improved varieties have been produced in a range of agricultural and horticultural crops, including in traditional crops (e.g. ginseng);

- introduction of new foreign varieties, especially varieties of ornamental crops such as rose, providing immediate benefits for the flower industry of the Republic of Korea, one

of the fastest developing sectors of agriculture in the country; introduced varieties have been used by domestic breeders for further breeding;

- increase in the number of breeders of certain crops, such as rice and rose;

- stimulation of certain sectors of plant breeding; for example, in the rice breeding, new types of breeders such as individual rice breeders (farmer breeders) and university researchers, have appeared. Since the introduction of PVP there has been an important transformation in the rice breeding sector to meet the evolving demands for rice. In the sector of rose breeding, private breeders have appeared and the number of domestic varieties has increased.

Overview of the development of the UPOV system

This study started in Section II with an overall review of the development of the UPOV system.

The developments in the 20 "oldest" UPOV members show the importance of an international PVP system. Put simply, farmers, growers and breeders have had access to the best varieties produced by breeders throughout UPOV members and have been shown to be taking full and increasing advantage of that opportunity.

Section II also demonstrated the scale of the impact of the CPVO system within the European Community showing that, whilst the number of applications for protection with the CPVO has continued to increase, breeders have been able to substantially reduce the overall number of applications required for equivalent, or wider, protection within the European Community.

With regard to countries which have joined UPOV in the more recent past, it is already possible to consider impacts which became apparent immediately on joining UPOV, or soon thereafter. The majority of countries which joined UPOV between 1993 and 2000 and, therefore, for which it has been possible to obtain useful data, were countries in transition to a market economy (Bulgaria, Czech Republic, Estonia, Kyrgyzstan, Republic of Moldova, Russian Federation, Slovakia, Slovenia and Ukraine) or were Latin American countries (Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Mexico, Panama, Paraguay and Uruguay). Of the remaining seven countries which joined UPOV between 1993 and 2000 (Austria, China, Finland, Norway, Portugal, Trinidad and Tobago and Kenya), China and Kenya are the subject of individual country profiles in this Study.

An overview summary of the 10 Latin American countries which joined UPOV between 1993 and 2000 is provided in Figure 10. It is apparent that joining UPOV was characterized by a substantial demand for variety protection and, in particular, a large influx of foreign varieties (applications by non-residents). A high proportion of non-resident applications appear to relate to ornamental varieties. In that regard, it can be observed that access to such varieties is crucial to enable producers in those countries to meet the demands of the global market place and indicates how the lack of an effective and internationally recognized PVP system can act as a barrier to global trade.

An overview summary of the eight countries in transition to a market economy which joined UPOV between 1993 and 2000 is provided in Figure 11. It is apparent that joining

UPOV was accompanied by a substantial demand for variety protection, with the majority of applications made by domestic breeders.

In summary, the review in Section II demonstrates the positive response for countries joining UPOV and demonstrates that the expansion of UPOV has led to the introduction of more varieties for both "old" and "new" members of the Union. It also recalls that membership of UPOV provides important technical assistance and maximizes opportunities for cooperation, which enables PVP to be extended to the widest range of plant genera and species in an efficient way.

## Overview of the Impact of Plant Variety Protection

Having reviewed some of the impacts of PVP at the national and international level it is possible to identify some common or universal themes, although their detail in terms of crops and speed of the occurrence can vary. The following is a summary of those themes:

### *Importance of PVP and uptake of protected varieties*

A strong argument can be made that the importance of the PVP system and protected varieties can be observed simply by the occurrence of protected varieties. It is observed that, since there is significant cost involved in obtaining protection, breeders will not seek variety protection for their new varieties unless, firstly, protection is necessary and, secondly, their varieties have true market value. Strength is given to the first part of that argument by the observation that breeders have made less routine use of the PVP system where they have other forms of control over their varieties, for example in the case of some hybrid varieties. With regard to the second part, there is information to demonstrate that the uptake of new, protected varieties is very strong and rapid even though, in most cases, a royalty payment is included in the cost for farmers and growers with new protected varieties. Farmers and growers make the choice of new, protected varieties over existing non-protected varieties, the availability of which is not affected by the PVP system, i.e. the existing non-protected varieties remain freely available to farmers and growers after the introduction of PVP.

In the case of Kenya, it was clarified that PVP titles for many Kenyan-bred varieties are in the hands of public institutions and local farmers can use the propagating material of the new, protected varieties under privileged conditions; for example, subsistence farmers have been permitted to exchange seed among themselves.

### *Number of New Varieties*

Individual country reports have demonstrated increases in the overall numbers of varieties developed after the introduction of PVP. New, protected varieties have been developed for a wide range of crops including, for example, staple crops in the agricultural sector (e.g. barley, maize, rice, soybean, wheat), important horticultural crops (e.g. rose, Chinese cabbage, pear), traditional flowers (peony, magnolia, camellia in China) forest trees (e.g. poplar in China) and traditional crops (e.g. ginseng in the Republic of Korea). It is also apparent that it is important for countries to extend protection to all genera and species in order to receive the full benefits of PVP.

*Improvement of Varieties*

As noted above, it can be argued that breeders will not protect their new varieties unless their varieties have true market value and that, furthermore, the final assessment of the value of a variety is made by the user of the variety. However, the individual country reports have demonstrated some of the ways in which new, protected varieties represent improvements. For example, in Poland, varieties must demonstrate that they are improved varieties in order to be included in the National List comprising the varieties of agricultural, vegetable and fruit plant species whose seed can be legally produced and marketed in Poland. In crops such as barley and potato, increased numbers of new, protected varieties have been associated with increased numbers of varieties on the National List. In Argentina, evidence of the improved performance of new, protected varieties has been found in crops such as wheat and soybean where the demand for new, protected varieties is shown by their increased proportion of the certified seed area, which has risen from 18% to 82% and 35% to 94%, respectively, since the introduction of the UPOV-based PVP law and UPOV membership. Within the individual country reports a range of examples of varieties with improved features have been provided in the form of text boxes.

*Introduction of Foreign Varieties*

An almost universal observation in the Impact Study was that the introduction of the UPOV PVP system and, in particular, membership of UPOV was accompanied by a large number of variety applications by foreign (non-resident) breeders, particularly in the ornamental sector, which was seen to be enhancing global competitiveness for producers.

A particular illustration of this was found in Argentina. Prior to adaptation of its national law on plant variety protection to the UPOV Convention and membership of UPOV, Argentina had a plant variety protection system in force and offered protection to non-resident breeders on a mutual reciprocity basis. However, full adaptation of the national law to the 1978 Act of the UPOV Convention and UPOV membership had an immediate positive effect on the number of titles granted for new varieties from non-residents. The report from Kenya noted that the introduction of foreign varieties, contributed to the diversification of the horticultural sector (for example the emergence of the flower industry) and supported the competitiveness of Kenyan products (cut flowers, vegetables and industrial crops) in global markets. Similarly, in the Republic of Korea, the introduction of new foreign varieties, especially varieties of ornamental crops such as rose, was noted to provide immediate benefits for the flower industry of the Republic of Korea, one of the fastest developing sectors of agriculture in the country. Poland experienced the same influx of foreign-bred varieties and China reported the start of an introduction of new, foreign varieties, in particular for ornamental varieties. The overview summary of the 10 Latin American countries which joined UPOV between 1993 and 2000, provided in Section II, indicated that joining UPOV was characterized by a substantial demand for variety protection and, in particular, a large influx of foreign varieties, with a high proportion of those applications relating to ornamental varieties. In that respect, it is recalled that the ornamental sector is both diverse and dynamic and restricting the number of plant genera and species for which protection is offered can restrict the scale of the influx of foreign-bred varieties.

An additional factor which was noted with regard to the introduction of foreign-bred varieties was that, according to the breeder's exemption in the UPOV Convention foreign varieties could, and were, used by domestic breeders in the development of their breeding programs.

*Domestic breeding*

Impacts of PVP on domestic breeding could be seen with regard to the number of breeding entities and the type of breeders and breeding activities.

*(a) Number of breeding entities and varieties*

Assessing the number of breeding entities presents a number of difficulties with regard to the availability of useful data. However, the report from Argentina provided information on an increase in the number of domestic breeding entities seen, for example, in soybean and wheat, most of which occurred in the private sector. The report from Republic of Korea demonstrated an increase in the number of breeders of certain crops, such as rice and rose. Poland reported an increase in the number of commercial breeding entities and an overall increase in the number of improved varieties despite a reduction in state-funded breeding and an overall decline in the number of breeding entities. China reported on the stimulation of commercial breeding activities in domestic public research institutes and domestic seed companies, with an increase in the number of breeders (e.g. maize and wheat in Henan Province) linked to increased numbers of PVP applications. It was also noted that the protected varieties resulted in income generation for breeders, including public research institutions and agricultural universities, and encouragement of further investment in plant breeding.

*(b) Types of breeders*

The Republic of Korea reported on the stimulation of certain sectors of plant breeding. For example, in rice breeding, new types of breeders such as individual rice breeders (farmer breeders) and university researchers, have appeared. Since the introduction of PVP there had also been an important transformation in the rice breeding sector to meet the evolving demands for rice. In the sector of rose breeding, private breeders had appeared and the number of domestic varieties had increased. In Kenya, facilitation of public / private partnerships for plant breeding, including partnership between international research institutes (CGIAR) and Kenyan seed companies, and emergence of new types of breeders (university researchers, private farmer-breeders) were reported.

*Membership of UPOV*

The review in Section II and the individual country reports demonstrates the positive responses which have been seen for countries introducing the UPOV PVP system and also the significant impact of countries joining UPOV. In addition, the developments in the 20 "oldest" UPOV members, as summarized in Section II, indicates the importance of an international PVP system and the benefits for all UPOV members as the Union grows in membership. Put simply, farmers, growers and breeders have access to the best varieties produced by breeders throughout UPOV members. It is also important to note that membership of UPOV provides important technical assistance and maximizes opportunities for cooperation, which enables PVP to be extended to the widest range of plant genera and species in an efficient way for the benefits to be maximized.

ANNEX I:

MEMBERS OF THE INTERNATIONAL UNION FOR THE PROTECTION OF NEW VARIETIES OF PLANTS

For the latest status, please refer to UPOV website:
http://www.upov.int/en/about/members/pdf/pub423.pdf

STATUS ON SEPTEMBER 15, 2005

| State/Organization | Date on which State/Organization became member of UPOV | State/Organization | Date on which State/Organization became member of UPOV |
|---|---|---|---|
| Albania | October 15, 2005 | Kyrgyzstan | June 26, 2000 |
| Argentina | December 25, 1994 | Latvia | August 30, 2002 |
| Australia | March 1, 1989 | Lithuania | December 10, 2003 |
| Austria | July 14, 1994 | Mexico | August 9, 1997 |
| Azerbaijan | December 9, 2004 | Netherlands | August 10, 1968 |
| Belarus | January 5, 2003 | New Zealand | November 8, 1981 |
| Belgium | December 5, 1976 | Nicaragua | September 6, 2001 |
| Bolivia | May 21, 1999 | Norway | September 13, 1993 |
| Brazil | May 23, 1999 | Panama | May 23, 1999 |
| Bulgaria | April 24, 1998 | Paraguay | February 8, 1997 |
| Canada | March 4, 1991 | Poland | November 11, 1989 |
| Chile | January 5, 1996 | Portugal | October 14, 1995 |
| China | April 23, 1999 | Republic of Korea | January 7, 2002 |
| Colombia | September 13, 1996 | Republic of Moldova | October 28, 1998 |
| Croatia | September 1, 2001 | Romania | March 16, 2001 |
| Czech Republic | January 1, 1993 | Russian Federation | April 24, 1998 |
| Denmark | October 6, 1968 | Singapore | July 30, 2004 |
| Ecuador | August 8, 1997 | Slovakia | January 1, 1993 |
| Estonia | September 24, 2000 | Slovenia | July 29, 1999 |
| European Community | July 29, 2005 | South Africa | November 6, 1977 |
| Finland | April 16, 1993 | Spain | May 18, 1980 |
| France | October 3, 1971 | Sweden | December 17, 1971 |
| Germany | August 10, 1968 | Switzerland | July 10, 1977 |
| Hungary | April 16, 1983 | Trinidad and Tobago | January 30, 1998 |
| Ireland | November 8, 1981 | Tunisia | August 31, 2003 |
| Israel | December 12, 1979 | Ukraine | November 3, 1995 |
| Italy | July 1, 1977 | United Kingdom | August 10, 1968 |
| Japan | September 3, 1982 | United States of America | November 8, 1981 |
| Jordan | October 24, 2004 | Uruguay | November 13, 1994 |
| Kenya | May 13, 1999 | Uzbekistan | November 14, 2004 |

(Total: 60)

ANNEX II:

STATES AND ORGANIZATIONS HAVING INITIATED
THE PROCEDURE FOR ACCEDING TO THE UPOV CONVENITON

For the latest status, please refer to UPOV website:
http://www.upov.int/en/about/pdf/pub437.pdf

**Status on September 15, 2005**

## States (18) or Organizations (1) Which Have Initiated With the Council of UPOV the Procedure for Becoming Members of the Union

Armenia, Costa Rica, Egypt, Georgia, Honduras, Iceland, India, Kazakhstan, Malaysia, Mauritius, Morocco, Serbia and Montenegro, Tajikistan, The former Yugoslav Republic of Macedonia, Turkey, Venezuela, Viet Nam, Zimbabwe, as well as the African Intellectual Property Organization (Benin, Burkina Faso, Cameroon, Central African Republic, Chad, Congo, Côte d'Ivoire, Equatorial Guinea, Gabon, Guinea, Guinea-Bissau, Mali, Mauritania, Niger, Senegal, Togo (16)).

ANNEX III:

PROFILES OF THE PARTICIPATING COUNTRIES

| Country | Argentina | China | Kenya | Rep. of Korea | Poland |
|---|---|---|---|---|---|
| Continent | South America | Asia | Africa | Asia | Europe |
| | | | | | |
| Surface (thousand sq. km, 2001) | 2,780 | 9,598 | 580 | 99 | 323 |
| Population (millions, 2001) | 37 | 1,272 | 31 | 47 | 39 |
| Population density (per sq. km, 2001) | 14 | 136 | 54 | 480 | 127 |
| GNI (billion US$, 2001) | 260.3 | 1,131.2 | 10.7 | 447.6 | 163.6 |
| GNI per capita (US$, 2001) | 6,940 | 890 | 350 | 9,460 | 4,230 |
| Rural population (% of total, 2001) | 12 | 63 | 66 | 18 | 37 |
| Land area (thousand sq. km, 2000) | 2,737 | 9,327 | 569 | 99 | 304 |
| Land use (% of land area, 2000) | | | | | |
| --Arable land | 9.1 | 13.3 | 7.0 | 17.4 | 46.0 |
| --Permanent cropland | 0.8 | 1.2 | 0.9 | 2.0 | 1.1 |
| --other | 90.1 | 85.5 | 92.1 | 80.6 | 52.9 |
| | | | | | |

ANNEX IV:

PLANT VARIETY PROTECTION REGIME OF THE PARTICIPATING COUNTRIES

| Country | Argentina | China | Kenya | Poland | Rep. of Korea |
|---|---|---|---|---|---|
| Establishment of PVP system | 1973 | 1997 | 1998 | 1987 | 1997 |
| Laws/Regulations | Law N°. 20.247/73 on Seed and Phytogenetic Creations of March 30, 1973<br>Implementing Decree no.2183/91 to the Law on Seed and Phytogenetic Creations (Boletín Oficial of November 1, 1991)<br>Law No. 24.376/94 | Regulations of the People's Republic of China on the Protection of New Varieties of Plants of 1997 | The Seeds and Plant Varieties Act of 1972, (As last amended in 2002) | Seed Industry Law of October 10, 1987 | the Seed Industry Law of December 6, 1995 as revised on January 26 2001 |
| UPOV membership (since) | December 25, 1994 | April 23, 1999 | May 13, 1999 | November 11, 1989 | January 7, 2002 |
| Act by which the country is currently bound | 1978 Act | 1978 Act | 1978 Act | 1991 Act | 1991 Act |
| Number of genera and species eligible for protection | All genera and species | As of October 2005, protection is offered to 119 genera and species | Any kind of plant other than algae and bacteria | All genera and species | As of October 2005, protection is offered to 155 genera and species, and will be extended to all genera and species by 2009. |

# ANNEX V:

# REFERENCES TO TABLES, FIGURES AND BOXES USED IN THIS REPORT

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[2] submitted up to October 2004

| | | |
|---|---|---|
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Boxes

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