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COMMISSION ON GENETIC RESOURCES FOR FOOD AND AGRICULTURE ACTING AS INTERIM COMMITTEE FOR THE INTERNATIONAL TREATY ON PLANT GENETIC RESOURCES FOR FOOD AND AGRICULTURE

COMMERCIAL PRACTICE IN THE USE OF PLANT GENETIC RESOURCES FOR FOOD AND AGRICULTURE

by

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This document was prepared at the request of the Secretariat of the Commission on Genetic Resources for Food and Agriculture acting as Interim Committee for the International Treaty on Plant Genetic Resources for Food and Agriculture, in order to provide background information on commercial practice in the use of plant genetic resources for food and agriculture to the Contact Group for the Drafting of the Standard Material Transfer Agreement, which was established by the Interim Committee at its Second Meeting.

The content of this document is entirely the responsibility of the author, and does not necessarily represent the views of the FAO, or its Members.

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1. INTRODUCTION

1. The International Treaty on Plant Genetic Resources for Food and Agriculture, in Article 13.2d(ii), provides for a Standard Material Transfer Agreement (SMTA), to be adopted by the Governing Body, for use with plant genetic resources for food and agriculture from the Treaty's Multilateral System of Access and Benefit-sharing. Article 13.2d(ii) provides that the SMTA:

> *[…] shall include a requirement that a recipient who commercializes a product that is a plant genetic resource for food and agriculture and that incorporates material accessed from the Multilateral System, shall pay […] an equitable share of the benefits arising from the commercialization of that product, except whenever such a product is available without restriction to others for further research and breeding, in which case the recipient who commercializes shall be encouraged to make such payment.*
>
> *The Governing Body shall, at its first meeting, determine the level, form and manner of the payment, in line with commercial practice.*[2] *The Governing Body may decide to establish different levels of payment for various categories of recipients who commercialize such products; it may also decide on the need to exempt from such payments small farmers in developing countries and in countries with economies in transition. […]*

2. The purpose of the present study is to assemble, review and categorize the available information on commercial practice in relation to plant genetic resources for food and agriculture, including on the level form and manner of payments.

3. This study is purely for the information. It does not make any suggestions whatsoever as to the possible content of the SMTA.

2. METHODOLOGICAL CONSIDERATIONS

2.1 Sources and availability of information

4. Obtaining reliable data (or indeed any data whatsoever) on commercial practice is difficult, for a number of reasons. It is therefore necessary to make a number of caveats.

5. The first and major limitation is that commercial transactions are frequently covered by trade secrecy, in that information on a particular company's commercial practices may provide advantages to competitors. Companies are unwilling or hesitant to provide information, in such cases. Moreover, the legal instruments companies use (for example, contracts, MTAs and licensing agreements) are private law instruments, and not a matter of public record. Bilateral agreements between seed companies usually contain a confidentiality clause, and are accordingly not publicly available, unless disclosed for some specific reason: there is, for example, some information that has become public in court decisions, following litigation between companies, including on "technology fees".

6. However, there are some standard agreements used by individual companies, the main body of which is not confidential, although the attachments recording the exact terms of the agreement are.[3]

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[2] Emphasis added.

[3] Examples are Holden's Foundation Seeds' "Parent Seed Licensing Agreement" and "Commercial License Agreement".

7. Information can often be obtained by analyzing the publicly available prices of commercial seeds. For example, a comparison of the prices of a company's conventional and transgenic seed can give an indication of the added value of an agronomic trait, such as Bt insect resistance and herbicide tolerance. Such analyses are available, for example, from "The Context Network", a strategic management consulting group that provides value-based services to the food and agribusiness industry, which serves all major seed companies.[4] Doane Agricultural Services[5] provides interesting information through studies and in *Agprofessional Weekly*.[6]

8. While journals such as *Crop Science*, *UK Plant Breeding Abstracts* and *Plant Breeding News* (California) provide general information about seeds, they provide little specific information about commercial practice in the seed industry. Little relevant information is available from general websites.[7]

9. In preparing this document, a variety of published documents have been drawn upon (see *Bibliography*). Daniel Charles (2001) provides analysis of some "historical cases", and illustrates the difficulty of determining the potential value of a trait before a product is launched. Kerry ten Kate & Sarah A. Laird (1999) is also a valuable source of information.

10. Information was also requested directly from a number of seed companies and industry representative bodies. Some of the information that resulted is anecdotal, or incomplete.

11. It must also be stressed that most of the information gathered relates to the seed industry in developed countries and from major research-based seed companies. It should also be noted that information is given not only on crops listed in *Annex 1* to the International Treaty, but also on others, in particular cotton, where this is useful in identifying commercial practice.

2.2 The difficulty of estimating value, in commercial practice

12 Plant breeding typically combines a very large number of parent varieties to make a single, commercially acceptable variety, over perhaps decades of development. An example of how complex the parentage of a released variety may be is the "successful wheat variety in India called Sonalika. […] Expanded to five generations, the variety has 31 parental varieties in its ancestry and is the result of complex combinations, crosses, back-crosses, *etc*. Such complex pedigrees are typical of modern varieties rather than being exceptional".[8] In the case of Sonalika, an analysis of the contribution of parental varieties to its pedigree shows a range of between 7.42% and 0.10% (see *Appendix 1*). Such an analysis, however, cannot define the relative agronomic value contributed by the various parent stocks.

13. It is even more difficult to define their commercial value, because companies' commercial practices, and the value to them of specific germplasm, vary with their germplasm pool at any one time, and their relative competitive strength, which may vary by region (even within one country). Over time, a company's aim will be to optimize return on investment: a research portfolio will

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[4] http://www.contextnet.com/.
[5] http://www.doane.com/about.php.
[6] http://www.agprofessional.com/apweekly.php.
[7] Further there are numerous websites from international organizations, national governmental organizations, seed associations (international and national), seed companies, universities, *etc*., such as

- http://www.unep-wcmc.org/resources/publications/7_industrial/4.doc (some information on practice in accessing plant genetic resources for food and agriculture);
- http://www.ars-grin.gov/ ARS = USDA's Agricultural Research Service; GRIN is "Germplasm Resources Information Network";
- http://www.worldseed.org/, the website of the International Seeds Federation; and the websites of the European Seeds Association (ESA), the American Seeds Trade Association (ASTA).

[8] Srinivasan 2003, pp.430-1. See his figure 1 for a derivative history of Sonalika for five generations.

typically aim at a reasonable balance of projects in term of investment time required and the chances of success. Perceived value is sensitive to market conditions: if a company has excellent germplasm, but does not have a trait the market believes it needs, it risks loosing market share.[9] Moreover, it should be born in mind that many potential products in which a company has made an R&D investment never come to market, so it is difficult to compare overall R&D investment with the returns on individual products.

14. Problems in estimating the value of a plant genetic resource arise from the uncertainty regarding its potential use: even breeders can seldom assess accurately potential commercial utility and market demand. There is an inherent problem in distinguishing the value added by the genetic resources itself, and the value added by R&D. However, in simplified terms, the commercial value of seed can be seen as residing in two components, germplasm and traits. The state of knowledge regarding the material (for example, if the passport data make it possible to identify likely characteristics), and the proof of concept (in terms of how a trait is likely to add value to a product) also affect the perceived value. For seed companies, germplasm and traits get potential commercial value once a proof of concept is given. Seed companies are increasingly doing less or no basic research.[10] Exotic germplasm or landraces are perceived as having little practical value for a seed company, and their introgression into breeding lines is time-consuming and risky.

15. Thus far, commercially successful traits have been those improving performance and farming efficiency in major world crops (input traits). In the future, the seed industry will place increased emphasis on traits providing benefits to food and feed processors, the retail trade and end consumers (output traits). While it might, at first glance, appear easier to establish the value of a single trait or a limited number of well-defined traits, attempts during negotiations to evaluate the potential added value obtainable from a single trait or a well-defined trait combination are rarely successful and, in most cases, the estimates turn out to be wrong. A realistic estimate of the potential value of a trait cannot be made without exhaustive test data, and the proof of technical feasibility. However, it is the market that ultimately decides.

2.3 Stages of product development and commercialization

16. In considering commercial practice, so as to assemble information of relevance for the development of the SMTA, it is important to bear in mind that commercial operations (sale and purchase, licensing, joint ventures, *etc.*) take place at many stages of the development cycle. In fact, because (in the case of landraces, obsolete materials, *etc.*), characterization, evaluation and pre-breeding largely take place in the public sector, with the product freely available to all breeders on a non-exclusive basis, and because breeders are loath to cross unimproved materials into their advanced lines, there is very little evidence of commercial practice for the acquisition of unimproved materials.

17. *Table 1* is a schematic presentation of the development cycle. Much of the available information on commercial practice relates to advanced products in the development chain, such as elite lines, genes, traits and material for reproduction (breeder's and foundation seed, and vegetative propagating materials). Because of this, it is difficult or impossible to identify commercial practice in relation to the raw materials that are most often conserved and released from *ex situ* genebanks, including those of the Consultative Group on International Agricultural Development (CGIAR).

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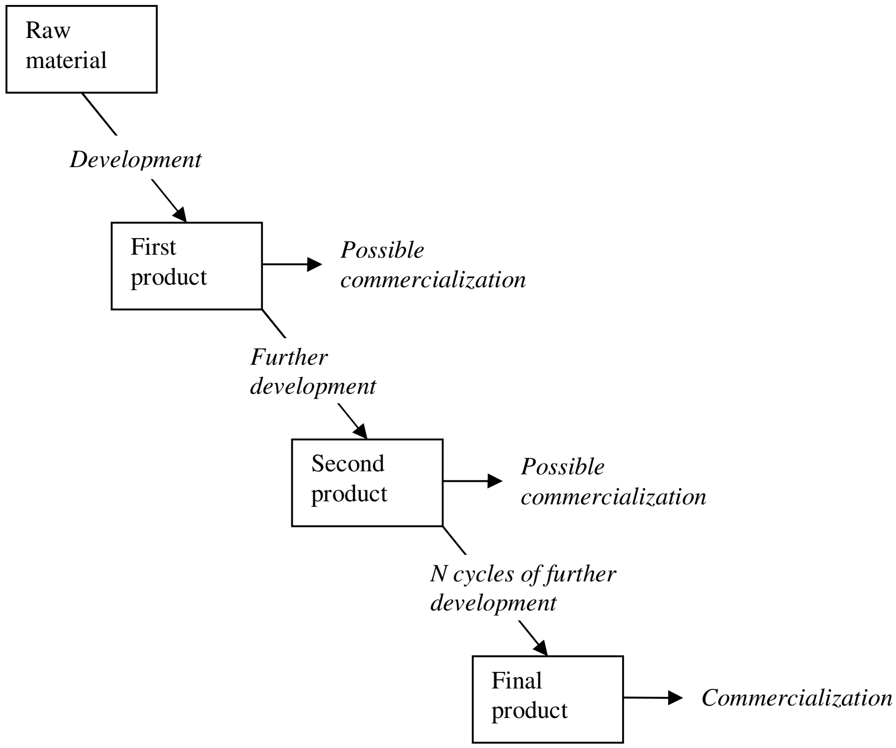
[9] This was the position of Pioneer, number 1 in the corn seed business when Ciba/Mycogen entered the market with "Bt corn" made resistant to the European Corn Borer by a trait obtained from a *Bacillus Thuringiensis* strain. The reverse is also true: when Bt cotton was launched in India, the Bollgard® trait was good, but the cotton germplasm did not meet farmers' requirements. Monsanto, who had licensed the trait, were blamed for unsatisfactory performance, which was in fact primarily due to low performance of the cotton germplasm.

[10] There is believed to be a trend in leading seed companies to decrease the R&D investments towards 10+-2 % on sales, in contrast with R&D expenditures of up to 23.2% on sales in the euphoric period for biotechnology, 1988/1989. R&D investment varies by crop, and, for example is higher for fruity vegetables and substantially lower for open-pollinated small grains, peas and beans.

TABLE 1: COMMERCIAL PRACTICE – STAGES OF PRODUCT DEVELOPMENT AND COMMERCIALIZATION



NOTES:

1. A product may be an elite line, genes, or genetic material (including reproductive and vegetative propagating materials), *etc*., for use in further research and breeding, as well as seed or planting material for direct sale. Products may be commercialized in various ways that affect their availability without restriction, *e.g*., by contract provisions; intellectual property rights (IPRs), such as plant variety protection (PVP) and patents; technological protection, *etc.*

2. A product may be developed into a further product by classical breeding, for example by pedigree breeding. Pedigree breeding starts with the crossing of two parents, each of which may have one or more desirable characteristics that is lacking in the other, or that complements the other. This cross results in a first plant generation (F1). Its seeds give rise to a plant population, superior plants of which are selfed (self-pollination) and selected in successive generations. If the two original parents do not provide all desired characteristics, other sources can be included in the breeding population. Typically, in the pedigree method of breeding, five or more generations of selfing and selection are practiced: F1➔F2, F2➔F3, F3➔F4, F4➔F5, *etc*. , in order to obtain elite lines.

   For hybrid production, *e.g*., of maize, the elite lines are tested for combinability with other elite lines. A single-cross maize hybrid results from a cross of two inbred lines having desirable combinability, and is designated F1 hybrid. The development of hybrids of annual crops, such as maize, normally takes eight years or more. The development of a hybrid of a bi-annual crop, such as cabbage or sugarbeet, takes about 15 years. Material obtained in a breeding programme can be used as starting material of another breeding program.

18. In effect, intermediate products may either be part of multi-stage product development within a single company, or may themselves be products that are marketed, and protected by various forms of IPR according to the decision of the owner and the nature of the product, in the context of the applicable national laws: these include trade secrecy, plant variety protection (PVP) and patents. Various contractual obligations and restrictions may also be imposed on the transfer of intermediate and final products.

19. On commercialization of a final product (seed or planting material), similar contractual or IPR conditions may apply, again with implications for the further use of the product for further research and plant breeding. Subject to certain considerations, such as those resulting from essential derivation, PVP under the UPOV Conventions allows the unrestricted use of a protected variety in further research and breeding and commercialization free of charge of the novel product thus obtained. Patenting may restrict the right to use the product for further research and breeding, depending on the applicable national patent law. In both cases, the IPR is for a limited period of time, after which the material is in the public domain. However, patents do not authorize commercialization free of charge of a product obtained by use of a patented product.

2.4. Comparability of information

20. A major methodological problem arises from the difficulty of comparing available information, even for a single crop, and the same or similar type of product.

21. There is no such thing as *standard* commercial practice: commercial practice varies enormously, in terms of the way in which companies structure their systems of R&D, and of production. They may, for example, charge different prices for the same product in different regions, even within the same country. They may also price their different products as part of a bundle, arbitrarily attributing costs to the individual products. New traits may substantially increase the commercial value of a plant species: this is for example true for soybean and cotton seeds, of which the commercial value increased substantially with the introduction of glyphosate-resistant trait.[11] They also use a variety of discrete legal instruments in commercializing their products, including contracts, PVP and patents, and, in certain crops, can obtain technological protection through the use of hybrids. All these factors make it difficult to compare information, and to seek communalities.

22. Moreover, where price figures exist, they are expressed in a number of different ways: for example, fixed sums or percentages, calculated on sales, net retail price, or acreage planted. The unit of seed sales may be by weight (and as crops have seeds of very different weight, the price by weight varies with the crop) or by a conventional unit, such as a "corn unit"[12] or a "dose".[13] Royalties paid by a farmer may also be expressed as an absolute sum per tonne of commodity produced (varying by crop).[14] The price of a PVP-protected seed is also very difficult to compare with the royalty paid by a farmer who produces his own seed of the protected variety on farm.[15]

23. The difficulty in comparing information means that much of the information assembled can best be regarded as anecdotal.

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[11] For example, before the development of glyphosphate-tolerant soybean seeds, Pioneer controlled about 10% of the US soybean seed market, and did not make much, if any, money selling soybean seed. Soybean seed was basically a service to corn farmers - Pioneer's real customers – who also happened to plant lots of soybeans.
[12] 80,000 viable seeds.
[13] In Europe: 50,000 corn-seeds.
[14] *E.g.*, for wheat, peas, chickpeas and faba beans in Australia.
[15] The royalty paid by farmers in EU countries for farm saved seed is substantially less than that paid by growers for the production of certified seed of the same variety.

3. COMMERCIAL PRACTICE

3.1 Evolving practice in the seed industry

24. The commercial world seed market is currently assessed at approximately US$ 30 billion. The seed business is in a consolidation phase. Three of the world's top ten seed corporations listed by RAFI, on the basis of 1997 revenues,[16] have disappeared or are about to disappear (see *Appendix 2*).

25. The emphasis of the private seed sector is on high value seed – primarily pure line field crops (corn, soybeans, cotton, canola), and vegetables (tomatoes, peppers, melons) – and on traits that improve performance and farming efficiency in major world crops. Major seed companies aim for higher average net selling prices for branded seed of good, improved yield, and lower seed production costs. They use advanced marker-assisted selection and breeding techniques for the development and production of high value commercial lines. As a result, less profitable species and varieties tend to be dropped.[17] This may open an opportunity for smaller seed companies: studies in the US seem to confirm that the number of US seed companies is increasing.

26. The major investors in biotechnology[18] are developing and introducing new, second generation traits, as well as combined (stacked) traits, to improve performance and widen the spectrum of activity. Increased emphasis is also being placed on developing products that provide benefits to food and feed processors, the retail trade and consumers.

27. Major seed companies report a gross profit (sales minus cost of goods sold) of about 50% or higher. The reported EBITDA (Earnings Before Interest, Taxes, Depreciation and Amortisation) data are not conclusive, in view of acquisition and litigation costs impairing the result, but several of the leading companies have, or aim to have, a mid-term EBITDA of about 25% on sales or higher.

3.2 Acquisition of starting material

28. Genetic resources that simply widen a company's gene pool but are without identified properties of interest have essentially no commercial value, as they require long-term investment and the return on that investment is risky. Much material, including pre-bred material, is available free from the public sector. Payment, if any, for exotic and unadapted material, and even pre-bred materials, will normally not exceed a nominal fee, such as US$ 5-20.

29. The value of material will increase with characterization and evaluation, if there is an indication of a trait or characteristic of potential commercial interest. Primarily in the vegetable area, if pre-bred material shows a potential value, lump sums in the range of US$ 5,000 to 50,000 may be paid for a limited number of pre-bred lines, in advanced development stage, which require only another 2-3 years development before commercialization. Such material will normally be obtained on a non-exclusive basis. There will normally be no prohibition of seeking IP protection for research results. Royalty rates will normally not be paid.

3.3 Hybrids

30. Hybrids provide breeders with a form of technological protection. "Hybrids account for nearly 40 percent of the global commercial seed business, and are available for many important commercial grains such as maize, sunflower, sorghum, oilseed rape, various fruity vegetables (tomato, pepper, melon), cabbages (such as broccoli), and to a limited extent rice and cotton".[19]

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[16] http://www.ghorganics.com/SeedIndustryGiants.htm .
[17] See for example Monsanto's decision to leave the European cereals business (wheat and barley seed).
[18] Monsanto, DuPont/Pioneer, Syngenta, Bayer and Dow.
[19] J. van Wijk, quoted in ten Kate and Laird (1999), p. 126.

31. Parent lines for hybrids, *per se*, are not commercially available, and the genetic material segregates in subsequent generations, so that, while all available genetic material from parent lines is available in the hybrid, they cannot be reproduced by farm-saved seeds.[20]

32. There is a trend to render access to cultivars for breeding purposes more difficult, at least in developed countries and particularly in the USA. At the same time, the enforceability of utility patents for varieties *per se* has been made more effective by use of a bag tag or sticker (*i.e.*, a shrink-wrap agreements affixed to a seed bag) authorizing the use of the seed for the production of end products, *e.g*; grain, but not for the production of seed or for research and/or breeding purposes.[21]

3.4 Plant Variety Protection

33. PVP, under the UPOV system, provides a rights-holder with the exclusive right to market a distinct, uniform and stable variety. Srinivasan (2003) has developed a methodology for estimating the private value of PVP certificates for the rights-holder in Europe, based on the willingness of the rights-holder to pay renewal fees for a variety. By "private value" is meant only the value that the rights-owner can obtain. For PVP certificates for agricultural crop varieties in Germany and the Netherlands, the median value of a PVP certificate is low: for varieties first registered in 1989, this was US$ 698 in France, US$ 156 in the Netherlands, and US$ 1,364 in Germany. High returns are obtained from a very few varieties: only 1% of the protected varieties were worth more than US$ 49,844 in France, US$ 11,093 in the Netherlands and US$ 45,620 in Germany. "The inescapable conclusion is that the bulk of PVP certificates provide only very limited economic returns to breeders. For agricultural crops, only 40-60% of PVP certificates survive for more than five years and less than 30% for more ten years. Only a very small fraction of certificates (less than 3%) survive for the full term (20 years)."[22] (Further methodological information and detailed results are given in *Appendix 3*.)

3.5 Royalties paid to breeders by seed-growers or farmers for the multiplication of protected varieties

34. Several national seed associations publish the royalties to be paid by growers as compensation for farm-saved seed or for authorized commercial production of protected certified seed.[23] In this case,

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[20] Access to proprietary varieties, be it parent lines, hybrids or open pollinated lines, for breeding purposes, can be blocked in those countries were plant varieties *per se* are patentable, such as Australia, Japan and the US.

[21] In the early nineties Pioneer granted non-exclusive royalty free licenses to use its patented corn hybrids in breeding, provided that the licensee agreed to share its hybrids with Pioneer. That policy was not maintained. More recently, there have been significant changes in the licensing policy of Holden's Foundation Seed (owned by Monsanto). Its 1991 license agreements granted a license to use each Corn Foundation Seed Variety for producing and selling Hybrid Seed Corn Varieties, and also allowed breeding with specific corn Foundation Seed Varieties, for research and the development of new corn lines, with the right to use such new lines for developing, using and selling Hybrid Seed Corn Varieties containing the new corn lines. The per unit royalty rate was about 4- 6 % of the net retail price of a seed unit.

Holden's more recent license agreements provide that no new projects related to the research and development of New Foundation Varieties may be initiated on and after December 1, 2005, and that, during the term of any US patent(s) or Plant Variety Protection certificates granted to the Licensor, applicable to the Licensed Hybrid or Foundation Variety, the royalty rate shall be doubled. They also contain a Grantback Rights clause, according to which Holden's gets, under certain conditions, a non-exclusive, perpetual, royalty-free, irrevocable worldwide license to make, have made, use, have used, sell or have sold any Licensed Hybrid, which is patented or subject to plant variety protection by the Licensee, and in which all parents are Licensed Foundation Varieties or are converted lines created by adding traits to Licensed Foundation Varieties.

However, there are however still organizations, primarily public sector organizations such as Illinois Foundation Seeds, Inc., that permit breeding of new lines with lines that they license to the industry.

[22] Srinivasan (2003), pp. 437-8.

[23] These include for example

- The British Society of Plant Breeders (BSPB), http://www.bspb.co.uk/visitors/licensing/licensing.html, there are well established examples of commercial practice, both in terms of how funds are collected, and in terms of royalty rates.[24] In Britain, for example, farmers are permitted to produce Farm Saved Seed (FSS),[25] for use on their holdings, and pay a royalty in one of two ways: (1) per tonne through the FSS Processor (a mobile or third party contractor) and/or (2) per hectare direct to the British Society of Plant Breeders Ltd, using an on-line form. The royalty rates in Britain are given in *Appendix **4***.[26]

35. In Europe, growers generally pay a royalty of € 2-9 for the production of 100 kg of certified protected cereal seed, and € 1 for 100 kg in Ireland, with a European-wide average of € 5-6. The € 2 applies primarily to Eastern European countries. It has been estimated that, in Europe, royalty rates of 10% and 4% respectively of the cost price of the seed are paid by a grower to the owner of a certified winter wheat and potato seed.[27] For gramineous forage seed, the royalty is in the area of € 5-17 for 100 kilos, depending on the country, and the particular crop. For ryegrass, the royalty is at the lower end of the scale, and for meadow grass the highest. For rapeseed, the royalties vary within a wide range of € 50-450 for 100 kilos, depending on the country and the variety, and for hybrid rapeseed the royalties may even reach € 600. For hybrid corn, royalties are in the range of 12-15% of net sales of certified hybrid seed, and in the range of 5-7 % of net sales for one parental line, for cereal seed a production fee in the range of 6-20% on net sales and for rapeseed in the range of from 8-30 % on net sales prices of certified (hybrid or non-hybrid) seed[28](see *Appendix 5*).

36. The royalties for corn in North America appear to be relatively close to those in Western Europe.

37. Contractual practices may further reinforce the rights-holder's position. According to the AWB Seeds (Australia)'s Seed Variety License (2005), each time a grower purchases PBR-protected seed varieties, the grower also enters into a license, "to plant Seed for the purpose of you producing grain therefrom (Commodity) and selling that Commodity as commodity (and not as seed). You must

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- Association de l'Industrie des Semences de Plantes Oléoprotéagineuses (AMSOL), Accords de Multiplication de Semences (soya, rapeseed, sunflower), http://www.amsol.asso.fr/multiplication/framemultipli ;
- and AWB Seeds, http://www.awb.com.au/AWBL/Launch/Site/AWBSeeds/Content/EndPointRoyalties/EndPointRoyaltyRates

[24] "*Licensing of Plant Intellectual Property and Royalty Collection*

"BSPB sub-licenses the plant variety rights of agricultural crops and collects the royalties due for the use of that seed/intellectual property. The Society functions by means of a Head licence granted to BSPB by the plant breeder, who holds rights in a particular variety. The Head licence gives BSPB the authority to issue sub-licences for the production and/or sale of First and Second Generation certified seed of their variety and to collect royalties on the sale of (e.g. cereals) and/or the hectarage sown (e.g. vining peas) of the certified seed. The royalty can only be paid once for one generation of a seed crop, so once that is paid the right has expired for that generation. Each plant breeder sets royalty rates for their own specific varieties. These are then given to BSPB to publish on a yearly basis.

"The sub-licences last from one year to three years depending on the crop species. They stipulate that royalties must be paid to the Society by a certain date. Declaration forms are distributed to sub-licensees, once or twice per year, listing all varieties and requesting them to complete and return the form with the correct sum of money. For example royalties for cereals are collected in June and December. Once collected, the royalties are then disbursed to the head licensors as soon as possible. Each head licensor will receive royalties collected on their particular varieties." (http://www.bspb.co.uk/visitors/licensing/licensing.html.)

[25] http://www.bspb.co.uk/visitors/fss/fss_intro.html.

[26] http://www.bspb.co.uk/visitors/fss/fss_comb_remuneration.html.

[27] van Wijk (1993), p.14.

[28] The latter range seems relatively narrow, but it is important to note that the price of a dose (50,000 seeds) varies depending on the region: in the Western Europe, a dose costs about € 10-14, while in Eastern Europe, a dose is sold for € 3-9.

not use Seed for any other purpose."[29] The commodity may be retained as seed for the purpose of subsequent planting, and is then also licensed under the terms of the agreement. The royalties per metric tonne of commodity vary between AU$ 1.10-3.30 for wheat, AU$ 2.20 for pea, AU$ 2.75 for chickpea, and AU$ 3.30 for faba beans.

38. In general, the production agreements do not include rights for the development of new varieties. There may be separate development agreements, but they are rather the exception.

3.6 The value of traits, from plant genetic resources, or other sources, in patents

39. The value of a trait depends on the stage of product development, whether the trait originates from plant genetic resources, or another sources, such as bacteria.

- If the trait is present in a seed, soil or other sample, but has not been identified, the trait may be patentable if it is novel, inventive and useful. However, according to current commercial practice, it is unlikely that any payment would be due to the supplier of the sample.

- If the sample shows certain properties, but the genetic link has not been identified, the seed industry will normally not be interested in obtaining access.

- If the trait has been identified, turns out to be expressed by one gene but has some defects (such as in the Nasanovia case),[30] companies may pay about US$ 5,000-20,000 for access. Patenting by the recipient may be possible but royalty payment to the donor is not the practice.

- Even once a trait has been identified, and the gene sequenced and cloned, there is still a high risk for a developer, if proof of concept has not been given (such as in the Xa21 case).[31]

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[29] http://www.awb.com.au/NR/rdonlyres/23B25BEE-DDAF-4372-9B5C-075343514BA0/0/SeedsLicense2005.pdf.

[30] The Nasanovia case relates to aphid resistance from a wild lettuce variety. The material was supplied, for a lump sum of *c.* US$ 10,000, by a seed collection to several companies. The disease resistance was known but linked to chromosome fragments that rendered it inappropriate for commercial use. Several companies were able to break the link, by classical breeding methods, and launched their disease-resistant lettuces. One of them applied for patent protection for the disease-resistant lettuce devoid of the unfavourable DNA segment. The examination procedure ran smoothly and patents were granted in the USA and by the European Patent Office. The company settled with several of its competitors for a royalty, or other compensation. At least one of the competitors decided to oppose the European patent. The R&D investment may have been worthwhile for the patentee, but the commercial benefit of the project was not predictable.

[31] The Xa21 case (information from ten Kate and Collins (1998)) demonstrates that the potential value of exotic material as a trait supplier is in general not measurable, that the development process takes many years, and that the chances to recoup money increases as the development progresses, but that the end result, in terms of return to investment, may be disappointing.

The Central Rice research Institute (CRRI), Cuttack, India obtained a sample of the Malian wild rice species, *Oryza longistaminata*. It screened the sample and established that it showed resistance to several strains of bacterial blight in India. The material was supplied to IRRI, which found that *O. longistaminata* was resistant to all six known races of bacterial blight in the Philippines. It conducted an intensive breeding programme from 1978 to 1990, and found, by crossing and backcrossing the variety with the widely used rice variety IR24 (which is know to be susceptible to rice blight) that the resistance was conferred by a small region of a single chromosome, and possibly a single gene. The resistant variety of IR24 was called IRBB21, from which the University of California, UC Davis, cloned and patented the gene in the US.

The University licensed the patent to two companies, one to work on barley and rice, the other on corn, for US$52,000 and US$ 30,000 respectively. These were option fees, which would become due at the time a product was commercialized. The parties have control over the material for a period, during which the patent term runs. The companies also paid US$ 825,000 to the university for research and other purposes. The agreement presumably contained a clause specifying that the royalty rate that would become due would be agreed upon well in advance of the launch of the product. To date (2005), neither company has moved to license

A seed company will normally seek an option or research agreement, invest in research for several years, and may also pay an option fee. The research or option agreement will normally not specify the conditions of the later commercial agreement, but state that the conditions should be discussed in good faith, when negotiating the commercial agreement. A cap may be foreseen, such that the royalty should not be higher than 2-5 % of net sales. The option fees may be entirely or partly deductible from later royalty payments. If there are deductibles (generally not), a cap may be specified. The licensor will normally give the party taking an option a limited time to evaluate commercial interest. (In the case of Xa21, the optionees were supposed to evaluate interest and do active research, but never did.[32]) If the licensor is, for example, a university, the optionee may request progress reports, and agree on milestone payments.[33]

A seed company may also license traits from research institutes that do not really fit it's pipeline, if they are believed to have some value as a potential chip in a license portfolio. In such cases, the licensee will often aim for a lump sum payment (about US$ 50,000-150,000), and avoid royalty payment obligations. Such projects often die in their embryonic stage.

- Traits with proof of concept are the most attractive, and various agreements may be reached to share the added value, although many other factors play a role, and the market ultimately decides.
  - *Appendix 6* indicates that for field crop traits, there is a potential 10-60 % added value, if unique and stacked.
  - An indication of how added value is shared may be derived from the belief that Monsanto leaves a seed company about 25% of the Round-up Ready technology fee, but the conditions for sharing royalty income can vary within wide ranges. For example, in cotton, Monsanto licensed traits to DPL and gets 70% of the technology fee for such traits, whereas, in another case, Syngenta gets 30% of the technology fee from DPL. There are however also examples of payments to the licensor of only 2% of licensee's royalty income from sub-licensees
  - For less exciting patented traits, a royalty of 3 % on net sales may deserve consideration.
  - Sometimes provision may be made for a segmented royalty, *e.g.*, payment of a 2% royalty on sales up to US$ 2 million, and 1.5% on sales in excess of 2 millions.

3.7 Synopsis of assembled information

40. With all the caveats stated about the paucity of information, and the difficulty of comparing information, two synoptic tables have been drawn up, analysing commercial practice and associated values, for plant genetic resources for breeding into existing lines (*Appendix 5*), or for use as such, and major traits (*Appendix 6*).

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the gene; nor started any research. The patent application filed at the European Patent Office was abandoned, presumable because the chances of meaningful patent protection in Europe were remote.

[32] This is not uncommon in industry.

[33] There are also research projects by universities funded by industry, for the development of new traits or new concepts.

APPENDIX 1

CONTRIBUTIONS OF DIFFERENT PARENTAL VARIETIES TO THE INDIAN WHEAT VARIETY, SONALIKA[34]

Name	Country	Contribution to pedigree (%)
AKAGOMUGHI	Japan	7.42
HARD RED CALCUTTA	India	7.23
RED FIFE	Canada	7.23
IUMILLO	Spain	6.64
KANRED	USA	6.64
JACINTH		6.45
LADOGA	Russia?	6.45
WHITE NAPLES	Australia	4.79
FIFE	Poland	4.79
MARIA ESCOBAR	Argentina	4.69
RIETI	Italy	3.71
KENYA 324	Kenya	3.13
SUPREZA	Mexico	3.13
B4946.A.4.18.2.1Y		3.13
YAROSLAV	USA	2.25
SQUAREHEAD	USA	1.86
IMPROVED FIFE	USA	1.86
MEDITERRANEAN	USA	1.76
TURKEY RED	USA	1.56
MARQUIS	Canada	1.27
POLYSSU	Brazil	1.17
ALFREDO CHAVES 6.21	Brazil	1.17
ORO	USA	1.17
ROTE DIKKOP		0.78
ZEEUWSE WITTE	Netherlands	0.78
DARUMA	Japan	0.78
FULTZ	USA	0.78
EGYPT NA 101	Egypt	0.78
CIDa : 5911 SIDa : 0		0.49
CID : 143390 SID : 0		0.49
TURKEY	USA	0.49
CID : 6332 SID : 0		0.39
EDEN	Australia	0.39
SASKATCHEWAN FIFE	Canada	0.39
SPIJK	Netherlands	0.29
HOPE	USA	0.29
THATCHER	USA	0.29
STEINWEDEL	Australia	0.29
INDIAN G	India	0.29
CERES-U	USA	0.20
AGUILERA 8	Mexico	0.20
DIEHL	USA	0.20
PURPLE STRAW	Australia	0.20
GAZA	Egypt	0.20
HORNBLENDE		0.20
K39788	USA	0.10
DOUBLE CROSS	Australia	0.10
FRONTEIRA	Brazil	0.10
MENTANA	Italy	0.10
CID : 800 SID : 0		0.10
CID : 801 SID : 0		0.10
FLORENCE	Australia	0.10

[34] From Srinivasan (2003), *Table 1*, pp. 432-3; pedigree over ten generations,

FORTYFOLD		0.10
FEDERATION Australia		0.10
ETAWAH	India	0.10
CID : 6313 SID : 0		0.10
CID : 6314 SID : 0		0.10
THEW	Australia	0.10
HUSSAR	Australia	0.10
TOTAL		**100**

Note:

The relative contributions of different parents to the variety have been estimated using the IWIS software developed by CIMMYT, Mexico. CID and SID refer to CIMMYT reference numbers for intermediate crosses. The country of origin of some of the parents is not known.

APPENDIX 2

THE TOP TEN SEED CORPORATIONS

Ranking 1997	Ranking 2005	Seed Company	2004 Sales (US$ millions)	Business	Acquisitions 2003 -2005
1	2	Pioneer	+ 2.000	Corn, soybean, traits	
2	1	Monsanto	+ 2.700	Corn, soybean, cotton, by acquisition of Seminis; global number 1 for vegetables; clear number 1 in traits	Seminis, Emergent Genetics Inc*
3	4?	Syngenta	*c.* .1.200	Corn and soybean position improved by acquisitions; sugarbeet; global number 3 in vegetables; also in flower business and traits	Garst, Golden Harvest (90%)
4	3?	Limagrain	*c.* 1.400	Corn, cereals, number 2 in vegetables; joint venture with KWS in US for corn	Advanta
5	-	*Advanta*	---	*Sold US corn/soybean bus. to Syngenta; then acquired by Limagrain*	
6	-	*Agibiotech*	-----	*Filed for bankruptcy in 2000; sales USD 425 in 1997*	
7	-	*Seminis*	*526*	*Number 1 seed vegetables, Acquired by Monsanto (was reportedly in debt and losing money)*	
8	6	Sakata (Japan)	*c.* 400	Vegetables, flowers	
9	5	KWS (Germany)	*c* 585	Corn, sugarbeet, cereals, oilseeds	
10	10	Takii(Japan)	*c.* 300??	Vegetables, flowers	
	6	Bayer Crop Science(Germany)	*c.* 400	Vegetables, traits	
	8	DLF-Trifolium (Denmark)	*c.* 380	Cool season clover and grass; cereals	Cebeco Seeds (feed grains, pulses, and flax)**
	9	Delta and Pine Land	*c.* 315	Cotton (worldwide number 1), soybean	

NOTES

* Emergent Genetics Inc., is the third largest cotton seed company in the USA (with 12% of US cotton seed market)

** Was reported number 11 of world's largest seed companies (by Rabobank, 1995); Monsanto was not even listed then.

APPENDIX 3

ESTIMATING THE PRIVATE VALUE DISTRIBUTION OF PVP CERTIFICATES

Note on Methodology

Srinivasan (2003) employs a "methodology of renewal model", which assumes that the value of a PVP certificate is endowed with a distribution of initial returns, which decays deterministically thereafter. Certificate holders must decide whether it is in their interest to pay certificate renewal fees, and the model assumes that holders thereby decide the lifespan of the certificates, so as to maximize the discounted value of net returns (*i.e.*, current returns minus renewal fees). On this basis, a function is developed, and the private value of PVP certificates is estimated.

By *private value* is meant that part that can be appropriated by the IPR holder, which reflects the returns attributable to the holding of IPRs alone. The methodology does *not* address the broader question of social benefits. The results suggest that the 'pure' returns to holding PVP certificates are modest. The overall returns from the production and sale of protected varieties may be much larger. There are other sources of economic returns in the seed business, *e.g.*, market power.

These data require careful interpretation, as they, for example, are not differentiated by crop, and filed PVP applications also have a defensive value, even after abandonment. Moreover, the practice is changing since the introduction of the essential derivation system within the UPOV 1991 Convention.

Value distribution of PVP certificates – agricultural crops
(all values in constant 1998 US$)
(from Srinivasan 2003, *Table 3*, pp. 438)

	France		*Netherlands*	*Germany*
	1980 cohort	**1989 cohort**	**1989 cohort**	**1989 cohort**
Value Distribution				
Mean	7,113.24	3,708.02	863.76	4,521.98
Minimum	.00	.00	.00	.00
Maximum	720,521.31	413,864.00	55,211.94	187,109.45
Percentile 25	378.18	124.22	.00	243.70
Percentile 50	1,726.19	698.17	156.03	1,364.29
Percentile 75	6,028.70	2,858.86	732.90	4,422.26
Percentile 95	28,079.44	15,139.61	3,880.55	19,305.17
Percentile 99	89,076.82	49,844.01	11,093.53	45,620.16
Range	720,521.31	413,864.00	55,211.94	187,109.45

APPENDIX 4

FARM SAVED SEED PAYMENT RATES FOR 2004/2005 IN THE UNITED KINGDOM

		UK£/ha			**UK£/tonne**
For all areas sown with FSS not processed by BSPB registered cleaners, the following £/ha rates apply.	Wheat	4.81	*For all tonnages processed by BSPB registered cleaners, the following rates apply.*	Wheat	29.17
	Winter barley	4.72		Winter barley	28.29
	Spring barley	5.24		Spring barley	31.19
	Oats	3.44		Oats	22.92
	Peas	4.80		Peas	25.97
	Beans	6.05		Beans	33.43
	Oilseed rape	7.69		Oilseed rape	1,419.01
	Linseed	7.60		Linseed	146.32
	Triticale	7.29		Triticale	42.87
	Yellow lupins	11.89		Yellow lupins	118.94

APPENDIX 5

SYNOPTIC TABLE: PLANT GENETIC RESOURCES FOR BREEDING INTO EXISTING LINES, OR FOR USE AS SUCH

Development status of the plant genetic resource	Species/country	Upfront payments	Result-dependent payments
Raw material, exotic material, land races	Not applicable	No payment; or US$ 5-20; some goodwill	No royalties
Materials with interesting passport information and in advanced prebred stage		US$ 5.000-50.000	No royalties
Protected pure lines, with the right to the grower to produce and supply farmers with such protected pure lines (data inconclusive)	Hybrid corn/EU	-	12-15%on sales
	Corn parent lines/EU	-	5-7% on sales
	Cereals/EU	-	5-6 €/ 100 kg
	Rapeseed/EU	-	50-450€/100kg
	Gramineaous forage seed/EU	-	5-17€/100 kg
	Wheat/Brazil (Embrapa)		1% net sales
	Soybean/ Brazil (Embrapa)		5% on net sales
	Cotton/ Brazil (Embrapa)		8% on net sales
	Cotton/Argentina (private)		6% on net sales
	Sunflower/Brazil(private)		7% on net sales
Protected pure lines, for use by competitors in hybrids (to fill temporary gaps in commercial material); breeding in general *not* authorized.	Sugar beet, elite	-	20-30% on sales
	Corn (China)	-	5% on sales
	Corn US, Holden's (past)	-	5-7% on sales
	Corn, Holden's new	-	8-12% on sales
	Vegetables	-	5-10% on sales

Notes:

1. This table is the result of considerable interpretation, and as such may contain a large margin of error.
2. The value of the data listed is very relative. Companies are reluctant to share contractual information. They also try and avoid disclosing information that may reveal weaknesses in their portfolios. Various factors (such as currency, subsidies, weather conditions, and the pest and infestation situation) further complicate the very difficult interpretation of the data.
3. Elite lines, the crown jewels of a seed company, may be very expensive. Licensing of elite lines to competitors is rare and usually occurs in the case of joint hybrids: the development of new elite lines from licensed elite lines is in general not authorized. The rather low royalties in corn and vegetables probably apply to unimproved material.

APPENDIX 6

SYNOPTIC TABLE: COMMERCIAL VALUE OF MAJOR TRAITS, AS A PERCENTAGE OF COMMERCIAL SEED PRICE

Species Trait	Seed Price (without trait) US$	Trait price ("technology fee") US$	Seed price (with trait) US$	Trait price as percentage of (seed+ trait) price
Canola RR	15.00-23.70/acre	15/acre	30-38.70/acre	38-50
Cotton US Bollgard		22/acre	30/acre	73
Cotton US Bollgard II		32/acre	40/acre	80
Cotton US Bollgard II + RR		42/acre	50/acre	84
Cotton US RR	8/acre	9/acre	19/acre	50
Cotton SA Bollgard	4.15/bag	2.375/bag	6.525/acre	27.5
Cotton technology fee per ha in Australia		98/ha		?
Cotton technology fee per ha in Argentina		78/ha		?
Cotton technology fee per ha in China		60/ha		?
Cotton technology fee per ha in India		60/ha		?
Transgenic Cotton technology fee in BR				30-40 %
Corn Conventional (av) USA	93.85			n.a.
Corn Elite (av) USA[1]	112.36			n.a.
Corn RR Conventional (av) USA		25.73	119.58	21.5
Corn RR Elite (av) USA		21.80	134.16	16
Corn Yieldgard Elite (av) USA		24.99	118.84[2]	21
Corn Yielgard /RR stack USA		16	111	14.4
Corn Conventional (6 companies) USA	103.45/unit			n.a.
Corn Yieldgard CRW (6 companies) USA		52.50/unit	155.95/unit	34
Soybean RR[3] USA		13.65/ 50 lbs bag	31.00/ 50 lbs bag	44.00 / 50lbs bag[4]

- RR = Roundup Ready®, provides for tolerance of the plant against glyphosate, a herbicide. The inserted gene interferes in the metabolism of the plant; it does not originate from a plant genetic resource.
- Bollgard® provides for insect control. The inserted gene is a gene obtained from a *Bacillus thuringiensis* (Bt) strain.
- Bollgard II® is a second generation insect control system, also from Bt.
- Yieldgard® provides for insect control. The inserted gene is a gene obtained from a Bt strain. It primarily controls the European Corn Borer.
- Yieldgard CRW provides for the control of the Corn Root Worm. The inserted gene is obtained from a Bt strain.
- av = average

Notes:

1. Note the difference between price of elite lines compared to conventional lines (which shows that less innovative lines are less profitable and likely to disappear from the market).
2. Data from 1999 suggest a figure of US$ 83-122 per bag in the USA, and US$ 75-177 per bag in Argentina. The trait price in Argentina would now be 30-40% of the net sales price for BT corn and 10-20% for RR corn
3. In Paraguay (where there is no patent protection for RR), there is an agreement to pay 1.5-3.5% on the value of each metric ton of *soy grain* sold, to be paid to grain traders for export (this corresponds roughly to about 15-35% on the net sale price of seed). In Brazil the technology fee would be 15% on net sales.
4. The technology fee has now risen from an initial $ 6.50 to 13.65 per 50 lbs unit (50lbs seed bag). The trait owner (Monsanto) thereby compensates for the declining price of Roundup, which is now out of patent.

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