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Submissions of the Canadian Environmental Law Association to the Legislative Committee on Bill C-15 - Plant Breeders' Rights

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I. INTRODUCTION

Then Canadian Environmental Law Association (CELA), founded in 1970, is a non-profit public interest organization specializing in environmental law. Since 1980 CELA has focussed both its casework and law reform efforts in the area of toxic chemicals, hazardous wastes and pesticides. However, CELA continues to deal with, on a daily basis, a wide range of environmental issues and problems. The issue of plant breeder's rights is an issue with significant implications in many areas including the environment and CELA welcomes this opportunity to make a submission on Bill C-15 before the House Committee.

CELA is opposed to Bill C-15 in principle. We believe that the Bill seeks to promote an agricultural system that is environmentally damaging and incompatible with the concept of sustainable development as outlined by the World Commission on Environment and Development (the Brundtland Commission) in its report Our Common Future.[1]

CELA submits that if Bill C-15 is passed it will encourage and accelerate the dangerous phenomena of genetic erosion and monoculturism and thus put at risk both the security of modern food production and the genetic resources of the planet itself. Should Bill C-15 be passed we will likely see an increase in pesticide use both in Canada and internationally with a comensurate rise in health and environmental problems. Bill C-15 will also seriously undermine efforts to establish an environmentally responsible system of organic farming in Canada and leave Canadians without a viable alternative to the often chemically saturated and nutritionally deficient products of the factory farm. In short, we believe that if Bill C-15 becomes law Canada will be making a significant and unnecessary contribution to the global environmental crisis.

CELA also endorses the concerns raised by other opponents to the

Bill. We are concerned that on an international level (Bill C-15 ensures Canada joins UPOV -the international vehicle for PBR) PBR issues will encourage strife and discord between first and third world nations. We question the philosophy of privatization that lies behind plant breeders' rights (PBR) legislation. We believe that this philosophy will result in a diminished role for the public sector in plant breeding research and development and that the goals of private corporate research will be directed more towards profit than the public benefit. We are opposed to any private interest acquiring monopoly rights over something as fundamental to human society as seeds - the first link in the food chain. We are concerned that farmers will face increased seed costs. We are fearful that it will be farmers and consumers who pay the costs of administering a PBR regime. Finally, we believe that Bill C-15 is the first step towards life patenting and that such an irreversible step should not be taken without further consideration by the Canadian people.

In our submission we will elaborate upon these general concerns and specific environmental concerns and conclude with suggested amendments to Bill C-15.

II. THE DEFINITION OF PLANT BREEDERS' RIGHTS (PBR)

Generally, plant breeders legislation is designed to extend to plant breeders a form of intellectual property protection. Intellectual property deals with intangible objects such as ideas and concepts and protection is usually granted to inventors through the use of trademarks, copyrights, patents and trade secrets. In countries with PBR systems, protection is usually granted through specific legislation rather than through the sphere of traditional patent protection.[2] Plant Breeders' Rights legislation would allow breeders to bypass these difficulties. Bill C-15 would grant to the developers of new plant varieties a form of intellectual property protection lasting for an 18 year period.

III. GENERAL CONCERNS

A. The History of PBR in Canada and Other Countries

1. Canada

Plant patenting has a long and unsuccessful history in Canada. First efforts to establish a plant patenting system were made by the Canadian Horticultural Society in 1923 when the first seed laws were being passed and in 1950 a Canadian Plant Patent Act was drafted but proceeded no further.[3] In 1960 a Royal Commission (the Ilsley Commission) examining the patent system unequivocally rejected a plant patent system. After reviewing the economic consequences of the patent system in general the Commission concluded that if Canada didn't already have a patent system it would be irresponsible to create one. The Commission then stated that the national economic consequences "of a plant patent system are still more dubious than that of the traditional patent system".[4] An agricultural task force of the House of Commons similarly rejected plant patenting in 1966. A Bill before the House of Commons in 1980 was defeated. In all cases it was felt that the proposed benefits of PBR legislation were simply outweighed by the deficiencies.

2. UPOV

Canada has been a signatory to the International Union for the Protection of New Varieties of Plants (UPOV) since 1979. However, in order to become a fully ratified member Canada must first pass its own PBR legislation. Bill C-15 is clearly predicated on the assumption that Canada will enter UPOV. For example, section 8 allows residents and citizens of other UPOV countries or countries with which Canada has bilateral PBR agreements to apply for protection under Canadian PBR legislation. Currently UPOV has 18 full members all of which could be fairly described as first world industrial nations.[5] The purpose of UPOV is to internationalize the scope of protection accorded to plant breeders.

However, the Canadian government has not been able to provide any hard evidence that UPOV and the philosophy of privatization that lies behind it will result in any appreciable public benefit. Neither have the other 18 full members of UPOV been able to demonstrate any appreciable public benefit.[6] It would appear that the main beneficiaries of PBR legislation are the private corporations which gain monopoly control over the seed industry.

Opponents of PBR claim that there has been no disproportionate growth in the breeding industries of those countries which have PBR compared with those which do not and that public breeding has actually declined in countries with PBR.[7] In fact, on the subject of PBR's history one commentator has remarked upon "the almost complete absence of any kind of survey or review of its impact and effectiveness".[8] CELA is concerned that the Canadian government may be about to pass legislation with far-reaching environmental consequences without a sufficient understanding of those and other negative impacts.

3. Alternatives to UPOV

Third World countries are noticeably absent from the UPOV membership. Many of these countries see PBR and the growing privatization of the global seed industry as detrimental to their interests. They are alarmed at the current practice and future prospect of first world nations freely taking raw genetic material from them, developing new plant varieties from these resources and then selling the new varieties back to the third world nations.[9] This neo-colonialist and exploitative attitude has created serious friction between first and third world nations and frustrates the common goal of global genetic preservation.

The International Board for Plant Genetic Resources (IBPGR) is a non-U.N. international organization whose mandate is to co-ordinate genetic resource activities. It is a "quasi-independent entity funded mainly by the World Bank-backed Consultative Group on

International Agricultural Research (CGIAR)".[10] The IBPGR is strongly supported by the developed countries for its work against genetic erosion (see infra 1V A). However, the IBPGR has been strongly criticized by Third World countries for favouring the interests of the developed nations through scientific grants and failing to guarantee free and unrestricted exchange of much of the world's collected germplasm (the genetic information encoded in the seed).[11]

In 1981 Mexico advocated an alternative to the existing system by calling for U.N control of the IBPGR; the establishment of an international plant gene bank; and a legally binding convention to ensure the full exchange of plant genetic materials.[12] In 1983, by way of response, the United Nations Food and Agriculture Organization (FAO) biennial conference authorized the International Undertaking on Plant Genetic Resources. The objective of the Undertaking (a document without legal force) is to ensure the preservation and scientific availability of plant genetic resources and it is grounded on the "universally accepted principle that plant genetic resources are a heritage of mankind and consequently should be available without restriction".[13] However, it proved impossible to reach a consensus on what was meant by "common heritage" - the LDC's sought to include all germplasm while the developed nations adamantly refused to include scientifically improved strains.

Eight industrial countries, including Canada, have reserved their position on the Undertaking.[14] The Undertaking's success is doubtful given the reluctance of developed countries to support an agreement which would divest private corporations of the fruits of their research.

CELA submits that the International Undertaking on Plant Genetic Resources represents an alternative approach to the UPOV system for dealing with the international problem of genetic erosion. From an

international perspective Bill C-15 is based upon a competitive system which encourages exploitative and antagonistic relationships between the developed and developing worlds. The international Undertaking is a preferable approach based on equitable principles and the free exchange of the genetic resources which make up our common heritage.

B) Exclusive Monopolies

CELA questions the morality of allowing private parties to take genetic material which has been shaped by the agricultural practices of countless generations of farmers, make a minor genetic alteration and claim an exclusive proprietary interest in the end result. As stated above, the genetic resources of this planet, and the diversity of plant life in particular, should be regarded as the common heritage of all.

In a persuasive discussion paper recommending against the adoption of PBR legislation, Manitoba's Minister of Agriculture has stated that it "is primarily the potential for monopoly control and not the opportunity for royalties which is the concern of the Manitoba government".[15] The increase in profit margins which usually follows a plant patent right facilitates take-overs and acquisitions so as to contribute to corporate concentration.[16] CELA submits that in the plant breeding field, corporate concentration, which invariably leads to monopoly market conditions, is not a socially desirable goal.

Those private corporations claiming proprietary interests in new seed varieties are unlikely to acknowledge the rights of the countries from which the original plant material was obtained. The Brundtland Commission reasoned that this,

> could discourage countries rich in genetic resources from making these internationally available and thus reduce the options for seed development in all

countries.[17]

C. Life Patenting

In the USA patents have already been granted for genetically altered animals[18] and animal patenting is simply a logical extension of the patenting of plants. CELA submits that a system which allows for the patenting of genetically altered animals and ultimately patented human genetic material is unconscionable not in the public interest. In addition to ethical and religious concerns there is the possibility for monopoly control over, for example, livestock agriculture. The Manitoba government claims that such legislation "establishes the theoretical and political basis for the monopolization of living substances in agriculture".[19] CELA believes that Bill C-15 represents the first step on a slippery slope for Canada and should not be passed into law.

D. The Privatization of Canadian Research and development

The experience of other UPOV members has shown that PBR legislation results in a "shift in emphasis in public sector plant breeding away from varietal development" towards basic and/or industry-support research.[20] If Bill C-15 is passed Canada's current world-class plant breeding program will be supplanted by private breeding controlled by multi-nationals with corporate agendas directed exclusively towards profit maximizing. At best, our public plant breeding program will likely assume a secondary role supporting the needs of private industry.

It will become increasingly difficult for Canadian farmers to reduce pesticide use without the research support of a well directed public program through the universities and Agriculture Canada. Given the extent to which large chemical companies dominate the seed industry (see infra 1V B) it would be unrealistic to expect private industry to do anything other than encourage pesticide use. The Brundtland Commission has stated that while

"[c]ommercial enterprises can help develop and diffuse technology ... public institutions must provide the essential framework for agricultural research and extension".[21] CELA submits that a high level of public sector involvement should be maintained in agricultural research.

E. The Costs to Farmers

Experience in other UPOV countries has shown that, with PBR legislation farming costs will increase when farmers are forced to purchase new seed every year.[22] Seed companies can maximize profits by selling hybrid varieties - the seeds of which do not breed true - and, therefore, must be re-purchased each year. In addition, the administrative costs of establishing PBR system are substantial and ultimately will be borne by farmers and consumers.[23]

IV. ENVIRONMENTAL CONCERNS

CELA believes that there are three major environmental arguments against Bill C-15. The first argument is that PBR legislation will, by encouraging modern monoculture farming, increase the global loss of genetic diversity. Second, PBR legislation will increase pesticide use by encouraging multi-national chemical companies, through the prospect of monopoly patents, to continue their buy-up of seed companies thus allowing the sale of seed-fertilizer-pesticide packages to a captive market. Third PBR legislation will undermine organic farming and place severe limits on pesticide free agriculture by reducing the varieties of seed available.

A. Genetic Erosion and Monoculturism

Genetic erosion is the modern phenomenon of mass extinction of species and the resulting decline in the global gene pool. This permanent loss of the world's raw genetic resources has been well documented.[24] While a certain amount of genetic extinction is

biologically inevitable within the ebb and flow of evolution the current rate of extinction is dangerously high. One reason is that most of the world's centres of genetic diversity are located in third world nations of the southern hemisphere.[25] These natural gene banks are subject to constant damage from the pressures of deforestation, desertification, urbanization and expanding human populations. In addition, much of the germplasm that has been collected and stored around the world has been kept improperly with resultant losses of up to forty per cent in some cases.[26]

However, the major reason for genetic erosion is the modern agricultural emphasis on monocultures. The nature of modern agribusiness is such that producers focus on a very limited number of marketable crops with uniform characteristics. The most important characteristic of the improved crop is usually its high yield and other, seemingly less important, characteristics such as hardiness, disease resistance, nutritional value and adaptation to local climate may be lost. As Third World nations follow first world countries and shift away from subsistence farming with its diversity of crops towards large scale production agriculture the variety of crops grown and the different genetic strains within each species drops dramatically. Out of approximately 250,000 higher plant species 20 crops provide more than 90% of the world's food supply and three crops - maize, rice and wheat - provide more than half.[27] In America 6 varieties of corn make up 71% of the total corn crop and 72% of the potato crop is derived from only 4 varieties.[28]

Ironically, genetic erosion is mainly a result of the development of new high-yielding varieties which completely replace their more "primitive" predecessors. When existing native crop varieties or "landraces"[29] are replaced they often disappear completely simply because no one farms them any more. For example, India began this century with 30,000 varieties of rice plant but will likely end the century with only fifteen.[30] Not only is there little commercial

reason for the average farmer to continue growing a less marketable crop but there is likely to be no land available to do so. It is all taken up by the monoculture crops.

The dangers of such genetic uniformity are also well known. Adverse environmental forces such as pests, disease or drought will damage or destroy not one strain comprising a small percentage of the crop total but may wipe out the entire crop. This lack of genetic diversity was responsible for the Irish potato famine of the 1840's and the consequent deaths of close to two million people. Monoculture farming was also at the root of the 1970 corn leaf blight in the southern U.S.A. which destroyed 15%-20% of that country's corn crop.[31] The Florida orange industry (three varieties comprise eighty-six per cent of the crop) was similarly imperilled in 1984 by citrus canker thought to have been destroyed in Florida and the state was forced to burn seven million trees to control the canker's spread.[32] Indeed, our genetically uniform crops will be particularly vulnerable in the immediate future as unpredictable weather patterns presage the global climate changes of the "greenhouse effect".

CELA submits that large-scale agriculture's propensity to produce commercially desirable characteristics in its products at the cost of increasing genetic uniformity is foolhardy and not in the public interest.

CELA further submits that PBR legislation will encourage and accelerate that propensity. Although PBR would appear to lead to an increase in the number of new varieties created the majority of the new varieties are genetically similar and differ only on a superficial or "chrome and tail-fin" basis. PBR encourages cosmetic changes because it rewards those breeders who can maximize their collection of protected varieties and the easiest way to do this is through minor morphological alterations. The United Nations Food and Agricultural Organization has commented that the commercial

competitiveness inspired by PBR has "led to intensive breeding of new varieties on a limited genetic base, resulting on several occasions in widespread disease epidemics".[33]

While recent years have seen real increases in the number of genuine varieties developed the factors responsible are other than PBR. For example since the 1960's the development of jet cargo traffic has allowed northern breeders to continue their breeding programs in warm climates in the winter. This has allowed for double and triple growing seasons. Another factor has been the advent of the computer which allowed breeders to monitor a greatly increased number of plant crosses for a wide range of characteristics.[34]

The Brundtland Commission, in recognizing the gradual takeover of the seed industry by chemical and energy interests (see the next section) commented that,

> research and development, production and marketing need to be carefully guided so as not to make the world even more dependant on a few crop varieties - or on the products of a few large transnationals.[35]

CELA shares those concerns and submits that Bill C-15, if passed at all, ought to be severely modified so that its environmental effects, particularly with regard to genetic erosion be minimized.

B. Increased Pesticide Use

Over the past 20 years there has been a dramatic shift in corporate ownership in the seed industry. A long list of multi-national giants including Ciba-Geigy, Atlantic-Richfield, Monsanto, Sandoz, Shell Oil, Union Carbide and others have been quietly taking control of the seed industry and the consequences are disturbing.[36] Most of the acquiring corporations are primarily involved in agri-business, petro-chemicals or pharmaceuticals. The top five holders of plant breeder's rights under the U.S. Plant Variety Protection Act of 1970 were (in 1983) Upjohn, Sandoz,

Shell/Olin, Agrigenetics and ITT.[37]

It would appear obvious that such companies have acquired seed companies in order to sell a packaged product of seed and pesticide/herbicide. While this is a logical business direction to move in since the two products can be marketed and distributed in tandem it is clear that an increase in pesticide use is likely to result. For example, seeds may be sold already coated with chemical protectants. Or it is possible that research may be devoted to increasing the resistance of certain crops to greater applications of particular pesticides. According to an executive of Pioneer Hi-Bred the assumption behind the chemical companies' move into the seed industry is that "the new owners can improve the plant's resistance to the herbicides and pesticides that the company sells".[38] It has been reported that more than 50% of seed research and development within private industry is devoted to developing plant resistance to higher concentrations of agricultural chemicals.[39] This situation has arisen because in the rapidly developing world of biotechnology it is easier to modify the plant than to change the pesticide or herbicide.

The top two commercial breeding goals are the establishment of plant varieties with high yields which are easy to machine harvest.[40] However, these objectives are achieved at the expense of disease resistance. This weakness is addressed through the use of pesticides and herbicides. CELA is strongly opposed to any increase in the use of pesticides which clearly pose a constant and persistent health hazard. In the Third World alone an estimated 375,000 peasants become ill from pesticides every year and an estimated 10,000 die.[41] As to their effectiveness the U.S. Department of Agriculture reported that losses in corn production due to insect pests between 1942 and 1951 averaged 3.5%. In 1988 losses of corn to insect pests averaged 12% despite a thousand-fold increase in insecticide since the 1940's.[42]

CELA believes that PBR will encourage this increase in pesticide use by allowing private corporations with vested interests in commercial pesticides the opportunity for monopoly control of the seed industry.

C. The Impact on Organic farming

A further negative environmental consequence of PBR will be the undermining of organic farming or "sustainable" agriculture. As the number of available seed varieties diminish through a combination of genetic erosion and the marketing policies of seed breeders and producers it will become increasingly difficult to acquire less common seeds. Also, many of the seeds that are sold may be coated or otherwise packaged with chemicals thus rendering them useless for organic farming purposes.

CELA believes that organic farming is a viable alternative to the current model of large-scale agri-business and the environmental crises it generates. One such crisis is soil erosion which the Senate's Standing Committee on Agriculture, Fisheries and Forestry has concluded is the most serious problem facing Canadian farmers costing $1 billion a year in lost income.[43] According to the recent Greenprint Report,

> [s]oil degradation occurring across Canada is proof that the present system of agriculture is not sustainable over the long-term.[44]

As organic farming practices better serve the health of both people and the earth they should be encouraged wherever possible and certainly not discouraged by granting unfair monopolies to rival agricultural systems. CELA submits that the Canadian government should be doing more to encourage farming systems which are not chemically dependant. The Brundtland report has stated that strategies to avoid over-relying on agrochemicals will require

> changes in public policies, which now encourage the increased use of chemical pesticides and fertilizers. The legislative, policy and research capacity

for advancing non-chemical and less chemical strategies must be established and maintained.[45]

V. CONCLUSIONS AND RECOMMENDATIONS

CELA remains opposed to Bill C-15 on principle. However, should it be passed we would like to suggest the following amendments which may help mitigate the Bill's environmental impact.

A. Replace Exclusive Licenses with Automatic Licenses

The purpose of Bill C-15 is to extend to the developer of a new plant variety a degree of control over the production and use of the new variety at the expense of others. However, the Bill is unclear as to the precise nature of this control. Is it more akin to patent protection or to copyright protection? It appears that Bill C-15 will grant to a breeder an exclusive right to sell or manufacture a new plant variety. If the breeder wishes he/she may restrict the sale of the variety by charging an exorbitant price or may choose to withhold the variety from public distribution alltogether. The potential exists for the public to be held to ransom should a private corporation seek to withhold a particular variety from distribution, possibly in order to promote a new and improved variety. If the withholding party holds an exclusive right to the variety no one else would be allowed to produce or market it without their consent.

Under Bill C-15 the only recourse open to the public is to apply for a compulsory license under section 32. If successful, the applicant receives the rights to do anything that the original holder might have authorized another to do pursuant to section 5 - to sell, produce or otherwise make use of.

CELA submits that Bill C-15 should provide for a system of automatic licensing rather than exclusive licensing. Under a scheme

of automatic licensing breeders would still be assured of royalties for the development of new plants but would not be permitted to prohibit others from using the new variety. Automatic licensing would ensure that no person or corporation could acquire undue control over the public food supply through the ability to withdraw a widely used or important product from the market.

B. Public Participation on Board to Grant Exclusive Licenses

However, if Bill C-15 establishes a system of exclusive licensing then the issue of compulsory licensing assumes considerable importance. CELA is concerned that such licenses will be issued or refused only "where the Commissioner considers that it is appropriate to do so" (s.32(1)). CELA believes that such significant decisions should not be left to the absolute discretion of one individual but should receive input from a wide public constituency. To this end s.32 should be amended to provide for the creation of a special board, with public interest representation, to deal with applications for compulsory license.

C. Reduce the Term of Protection

CELA submits that the term of protection given to a new variety be reduced to a term of less than 18 years. A shorter term of protection, for example, seven years, could help reduce some of the adverse effects stemming from the monopoly control of the seed industry that is likely to result should Bill C-15 be passed. To this end section 6(1) should be amended so that the term of the grant of plant breeders' rights be reduced to seven years.

D. PBR Should Apply to Ornamental Plants Only

CELA submits that Bill C-15 should be restricted to ornamental plants and not apply to food crops. To this end the definition of "plant variety" should be modified so that it applies only to ornamental plants. Section 4(1) should be amended so as to exclude from PBR eligibility categories of cereals and vegetables whose contribution to the national diet is commonly recognized and

nutritionally significant.

E. Canadians Only

CELA submits that Bill C-15 should be amended so that it applies only to Canadian citizens. Existing intellectual property laws encourage an outflow of wealth from Canada to multi-national companies to the detriment of Canada. To this end section 8 should be amended so as to restrict Canadian plant breeders' rights to Canadian citizens.

F. Inventors not Discoverers

CELA submits that in order to avoid situations where third parties acquire monopoly rights to the products of farmer or gardener innovation Bill C-15 be amended so as to exclude discoveries. The term "breeder" should be re-defined so as to include only those who "originate" (not "discover") a new plant variety. The existing definition invites theft and may easily lead to abuses.

VI. ENDNOTES

1. The World Commission on Environment and Development, Our Common Future, 1987, Oxford University Press. Hereafter referred to as the Brundtland Report.

2. An exception is the USA where protection is available under the Plant Patent Act of 1930 for asexually reproducing plants (without seeds), the Plant Variety Protection Act of 1970 for varieties that produce by seed and under the general patent law for both sexually and asexually reproducing plants. The applicability of the general patent law was confirmed in Chakrabarty v.Diamond, 206 U.S. Pat. Q. 193, (U.S. Supreme Court, 1980), where the U.S. Supreme Court held that general patent protection was not precluded simply because the claimed invention encompassed living matter. See Williams Jr., Sidney B., "Protection of Plant Varieties and Parts as Intellectual Property", in 225 Science, 18, July 6, 1984.

3. Curren, Thomas, Legislative Summary : Bill C-15: Plant Breeders' Rights Act, Library of Parliament, May 15, 1989, at 2.

4. The Ilsley Royal Commission as quoted in Minister of Agriculture of Manitoba, Province of Manitoba Discussion Paper on Plant Patenting Legislation, November 1987, at 10. Mooney notes that a counterpart U.S. commission called for the abolition of the 1930 Plant Patent Act in the late 1960's. Mooney, Pat Roy, "The Law of the Seed", 1983 Development Dialogue, 3, at 142.

5. They are : Denmark, West Germany, Holland, Britain, Belgium, France, Israel, Italy, Japan, New Zealand, South Africa, Spain, Sweden, Switzerland, USA, Ireland, Hungary and Australia.

6. See Mooney, supra, note 4 at 149 to 162.

7. Manitoba government position paper, supra, note 4 at 13-14.

8. Mooney, supra, note 4 at 142. The Manitoba government position paper, supra note 4 at 13 states that the difficulty of predicting the impact of PBR in Canada is "confounded by the lack of hard data available on the experience of other countries".

9. Bordwin, Harold, J., "The Legal and Political Implications of the International Undertaking on Plant Genetic Resources", 12 Ecology Law Quarterly, 1053, Spring 1985, at 1058.

10. MacFayden, T., "A Battle Over Seeds", Atlantic Nov. 1985 36, at 41.

11. Bordwin, supra, note 9 at 1061-2.

12. Baxi, Upendra and Clarence Dias, "Preservation and Access to Plant Genetic Resources", International Comm. Jurists' Review, 49 at 49.

13. Ibid., at 62-3. Quoting from Article One of the Undertaking.

14. Bordwin, supra, note 9 at 1069.

15. Manitoba govt. position paper, supra note 4 at 7.

16. Mooney, supra, note 4, at 151. Mooney discusses the recognition of this phenomenon in a 1978 EEC decision concerning a French-German PBR licensing agreement.

17. The Brundtland Report, supra, note 1 at 139.

18. Schneider, Keith, "Life Patents: Doubts are Registering", August 7, 1988, New York Times. In April 1988 researchers obtained a patent on a mouse genetically altered so as to be more susceptible to cancer.

19. Manitoba government position paper, supra, note 4 at 24.

20. R.M.A. Lyons and A.J. Begleiter, "An Examination of the Potential Economic Effects of Plant Breeders' Rights in Canada", Consumer and Corporate Affairs Canada, Ottawa, (undated), at 30, as quoted in Curren, "Legislative Summary, supra, note 3 at 5.

21. Brundtland, supra, note 1 at 139.

22. Manitoba govt. Position Paper, supra note 4 at 19-20.

23. Ibid.

24. See, for example, Coggins, G.C. and A.F. Harris, "The Greening of American Law ? The Recent Evolution of Federal Law for Preserving Floral Diversity", 27 Natural Resources Journal 247, Spring 1987 #2.

25. These small pockets of genetic diversity are known as Vavilov centres after the Russian botanist who identified them. There are about 12 such centres all located in the Southern Hemisphere. MacFayden, "A Battle Over Seeds", supra, note 10 at 37.

26. Bordwin Supra, note 9, at 1057 at note 24, Upendra and Baxi supra, note 12, at 53.

27. Coggins and Harris, supra, note 24 at 253.

28. Bordwin, supra, note 9 at 1056 note 20.

29. Land races have been defined as "genetically-diverse, heterogenous mixtures of crop cultivars ... which have provided a rich supply of germplasm for crop variety breeding". Curren, supra, note 3 at 6.

30. Baxi and Dias, supra, note 12 at 52.

31. Bordwin, supra, note 9 at 1057 note 23.

32. MacFayden, supra, note 10 at 36.

33. Fowler, C. "Why Corporations Should not Patent Plants", 42 Business and Society Review 26 (1982) at 27.

34. Mooney, supra, note 4 at 153.

35. Brundtland Report, supra, note 1 at 218.

36. Fowler, supra, note 3 at 29, MacFayden, supra note 10 at 31, Curren, supra note 3 at 7.

37. Mooney supra, note 4 at 160.

38. Quoted in Mooney supra, note 4 at 125.

39. Hansard, June 27 1989 at 3747, The Honourable Charles L. Caccia, and GROW Newsletter, Vol.2, 1989 at 4.

40. Mooney, supra, note 4 at 122, quoting from "The Influence of Environmental Protection Measures on the Development of Pesticide Production and Consumption", U.N. Economic and Social Council (Economic Commission for Europe), 1982, at 83.

41. Baxi and Dias, supra, note 12 at 50.

42. U.S. Department of Agriculture statistics.

43. Soil at Risk, Report of Senate Standing Committee on Agriculture Fisheries and Forestry as quoted in Greenprint for Canada, infra, note 40, at 10.

44. Greenprint for Canada Committee, Greenprint for Canada : A Federal Agenda for the Environment, June 1989, at 10.

45. Brundtland, supra, note 1 at 135.