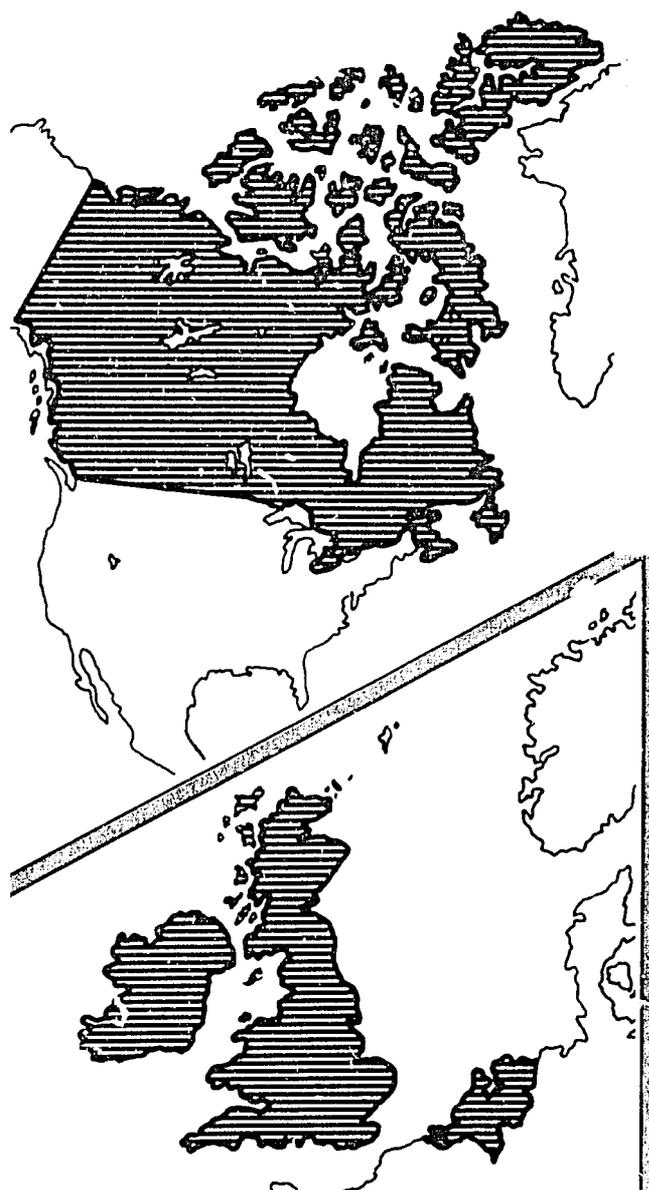


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Seed Potato Systems in Developed Countries: Canada, The Netherlands and Great Britain



by
Nick Young



**Seed Potato Systems in
Developed Countries:
Canada, The Netherlands and
Great Britain**

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1990

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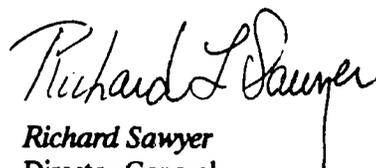
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Foreword

Agencies supporting potato improvement in developing countries generally place the highest priority on potato seed programs. The results of these efforts have been mixed due to the differing philosophies guiding the technologies being introduced and developed and the many physical and socioeconomic variables which may affect the performance and achievements of a seed program.

There are few comprehensive studies available which document the structure and function of seed potato programs in developing countries. Given the complexity and the key role seed programs have in any country's potato improvement, CIP has initiated a series of case studies of seed programs in both the developing and developed world. This is one of a series of studies; others will examine the seed potato systems in Ecuador, Kenya and the Philippines. These case studies offer a comprehensive look at the important informal seed sector, the official seed programs, and the interaction among the various elements of the informal system, the official program and farmers.

We expect the conclusions from these studies will help guide CIP activities in seed production and improvement and be useful to the national institutions involved and others concerned with the successful functioning of this vital component to the potato system of any country.



Richard Sawyer
Richard Sawyer
Director General
International Potato Center
Lima, Peru

Acronyms

ADAS	Agricultural Development and Advisory Service
BRR	Bacterial ring rot
COA	Commissie ter Bevordering van het Kweken en het Onderzoek van Nieuwe Aardappelrassen.
DAFS	Department of Agriculture and Fisheries for Scotland
DLO	Directie Landbouwkundig Onderzoek
DUS	Distinctness, uniformity and stability trials
IPO	Instituut voor Plantenziektenkundig Onderzoek
ITAL	Stichting ITAL
IVP	Vakgroep Plantenveredeling
IVT	Instituut voor de Veredeling van Tuinbouwgewassen
LH	Landbouwhogeschool Wageningen
MAFF	Ministry of Agriculture, Fisheries and Food
NAA	Nederlandse Aardappel Associatie
NAK	Nederlandse Algemene Keuringsdienst voor Zaa. 'aad en Pootgoed van Landbouwgewassen
NBPA	New Brunswick Potato Agency
NIAB	National Institute of Agricultural Botany
NIVAP	Nederlands Instituut voor Afzetbevordering van Pootaardappelen
NKB	Nederlandse Kwekers Bond
NRLO	Nationale Raad voor Landbouwkundig Onderzoek
NSDO	National Seed Development Organization
PAGV	Proefstation voor de Akkerbouw en de Groenteteelt in de Vollengrond
PBI	Plant Breeding Institute
PCC	Pootaardappel Contact Commissie
PD	Plantenziektenkundige Dienst
PEI	Prince Edward Island
PLRV	Potato leaf roll virus
PMB	Potato Marketing Board of Prince Edward Island or of Great Britain
PSTV	Potato spindle tuber virus
PVA	Potato Virus A
PVA	Produktschap voor Aardappelen
PVS	Potato Virus S
PVX	Potato Virus X
FVY	Potato Virus Y
RIVRO	Rijksinstituut voor het Rassenonderzoek van Cultuurgewassen
RVK	Raad voor het Kwekersrecht
SCRI	Scottish Crops Research Institute
SSPDC	Scottish Seed Potato Development Council
STOPA	Stichting Overleg Pootaardappelaangelegenheden
SVP	Stichting voor Plantenveredeling
VCU	Variety commercialization and utilization trials

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Preface

This study has been initiated as part of a wider investigation into potato seed systems. The study was conceived by and financed through the International Potato Center (CIP), Lima, Peru. The rationale for the developed country study was to establish the nature of the systems and the factors which had shaped them. Many of the issues faced by developing countries in relation to seed potato production systems are also found in many developed countries.

This is primarily a study of formal seed systems. Informal seed systems are unimportant in the three case studies examined. This does not mean that informal systems are not important in some temperate climate developed countries.

Acknowledgements are due to the many people who assisted the author during field visits to the countries covered. Thanks are also due to Dr Chessley Smith and Allan Parker in Canada, Dr. Douglas Hall in Scotland, Dr. Ineka Mastebroek in the Netherlands and Dr. Douglas Horton and Dr. Charles Crissman of CIP for their comments on the draft report.

Executive Summary

This report examines seed potato systems in developed countries using the case-studies of three important seed potato-producing countries; the Netherlands, Canada and Great Britain. It compares different systems with an emphasis on the nature of the institutional structure. Seed potato production and marketing is supported by a wide range of support activities, and involves a considerable challenge in terms of institutional organization.

In the three systems studied there has been considerable institutional intervention with the purpose of either sectorial development, social or equity adjustment -or user/consumer protection. The methods of 'intervention' are diverse. It is possible to discern those interventions which involve: the direct subsidization of the costs of seed multiplication or the various activities which support it; control over the way in which material enters the seed multiplication chain; control over the marketing of seed (including pricing); and restrictions on those who may participate in seed production. The legal framework can also be adjusted to devolve responsibility for certain of these activities to the industry itself. In addition, adjustment of the legal framework gives powers to the seed potato industry to raise funds to carry out activities for the common good and it can provide incentives for breeding through plant breeders' rights. While many of these interventions are justified by technical (plant health) arguments, they have an important effect on the character of the system and the balance of benefits accruing to different parties.

In general, the technical premise of seed certification or classification is well accepted because of the obvious vulnerability of the potato to disease breakdown, although in some areas there is concern that standards for certain relatively unimportant diseases are too high and that freeing tubers of disease may 'weaken' the potato.

The changing technologies associated with plant propagation are continually challenging the structure and organization of seed potato systems. The advent of micropropagation has provided the opportunity for more cost-effective freeing of material from disease. The industry is on the brink of further developments in plant propagation which will change the balance of cost between in vitro and soil-based methods. These will have greatest impact at the top of the multiplication pyramid where in vitro techniques are more competitive. The prospect is for shortening of the multiplication chain and contraction of the high-grade seed sector. Adjustment will be difficult where there are few alternative crops giving similar economic return.

Measuring the comparative performance of seed potato systems poses many methodological problems. It is unsafe to assess success without detailed consideration of the objectives of a particular seed program. However, in practice, these are often very narrow and vaguely-stated, ignoring broader issues of social and economic welfare of society as a whole. In practice, general appraisal of a seed potato system must take a multidimensional approach and any quantitative measure must be applied with care. In broader terms, any assessment of a sector must take account of success in terms of market share, but clearly it is necessary to be aware of the dangers of "buying" market share by diversion of public resources from other more economically deserving areas of activity in the economy. We are left with the rather unsatisfactory conclusion that the most appropriate model is one which has features which allow the sector to have all the information necessary to fully understand the needs of the customers and the basic structure of production and to support activities which ensure that the core seed-production activities can produce the final product as efficiently as possible. It is difficult to be prescriptive as the institutional framework which is appropriate must fit in with the political and administrative tradition.

There is no representative survey which allows comparisons in terms of seed potato quality and consequently it is impossible to draw conclusions on the technical efficiency of the different seed systems.

The Canadian, Dutch and British (Great Britain only) seed potato sectors produce similar volumes of seed potatoes. In both Canada and Great Britain a large part of seed volume is eventually sold on the table potatoes market. The Dutch seed potato system is almost completely separate from the production of table and processed potatoes. In terms of market share the Dutch industry has been by far the most important of the three with area and output expanding considerably between the early 1970's to the present day. Dutch seed potato export expansion has accounted for a large part of the area expansion of the sector, suggesting that it has a comparative advantage over the Canadian and British sectors. It is the largest exporter of seed potatoes in the world and as a result is an important influence on potato production in many countries.

The sectors differ considerably in terms of the environment. The Canadian industry has a short growing season, and the long harsh winters which are beneficial in terms of keeping to a minimum the problems associated with over-wintering pests and diseases. The industry in Great Britain is characterized by generally low aphid populations: this enables the production of tubers with good virus health. Cool wet harvest conditions have meant that the main plant health problems have been associated with certain bacterial diseases (e.g. particularly blackleg). Historically, the most serious problem in the Netherlands has been virus diseases, although recent years have seen a very substantial reduction of aphid populations and more concern about bacterial diseases (blackleg). In all three countries there is a history of seed potato production and certification and also a core of specialized seed potato producers, many of whom are highly dependent on the revenue from the crop.

The character of the three seed potato systems varies considerably. The Canadian system is characterized by the basic "framework" of federal legislation and support within which the provincial seed sectors can operate. The provincial institutions differ significantly, with strong rivalry between Prince Edward Island (PEI) and New Brunswick. The provinces have a substantial degree of autonomy in the method of organization of their seed potato sector other than in decisions on certification and general phytosanitary issues. However, federal assistance is considerable and extends to support for research, breeding, market regulation, credit, crop insurance, and more general areas of financial support.

There is sharp contrast between the two main seed producing provinces. The Prince Edward Island market environment is strongly influenced by the PEI Potato Marketing Board (now Potato Marketing Commission) whilst in New Brunswick the buying and selling of seed potatoes is less regulated and restricted. In Prince Edward Island all potatoes are certified leading to a substantial over-supply of seed potatoes and the absence of any significant premium over table potatoes. The positive feature of this is a much greater control over disease than would be otherwise obtained. In fact a history of incidence of two serious diseases, bacterial ring rot and potato spindle tuber viroid, has prompted a major federal and provincial effort to control these diseases which has had considerable success. Provincial disease eradication legislation has played a major part in this.

A key feature of the Canadian system is the absence of plant breeders' rights legislation. As there is no incentive for private potato breeding, the only Canadian varieties are created by the State sector which is dependant on these varieties and on those free varieties which are available from other countries. While this dependence has not seriously undermined its ability to service the domestic market, it has meant that there has been less incentive to develop the seed potato export market.

The character of the successful Dutch seed potato sector is influenced by the liberal nature of State involvement. Wherever possible, the State has attempted to pass on to the industry itself, the responsibility and funding for many of the essential support activities, including the all-important seed certification services. Many of these are funded by the industry through parafiscal taxes. The sector thus relies on self-imposed discipline and on the recognition that if any individual member cuts corners, the industry as a whole will suffer. Some compromise results from this, but whenever it poses any threat to the potential market for Dutch seed potatoes, the institutional mechanisms are there to apply the necessary correction.

An important cause for the character of the State involvement is the organization of the breeding sector, where the role of the State has been the support of the private breeding companies and not State/private competition. This has manifested itself in the form of the provision of services (such as

the supply of parental material) and legislation which provides incentive payments to breeders of successful varieties. The private breeders and their marketing companies are the engine of the entire Dutch seed potato sector. They have the incentive to expand markets by producing new genotypes and supplying seed quality which meets the requirements of domestic and foreign markets. The way the sector is organized means that there is very direct contact between the market place and the breeding effort. The breeders' marketing agents play a central role. They are at the interface with the market and as such play an important part; on a long-term basis, they guide the direction of the breeding effort; on a short-term basis, they commission the quality and volume of seed from seed potato producers to meet their perceived market requirements.

The Dutch system is indicative of confidence in that it allows the market to clearly dictate the direction of the sector and the nature of its products. A good example is in the decision of how much and who produces the initial multiplications of elite seed at the top of the multiplication pyramid. The Dutch would unambiguously impose no restrictions because they would be confident that their standards are high enough, their quality control is rigorous enough, and that growers and their marketing agents are sufficiently skilled in making prudent decisions on volume and quality requirements. Similarly, in the breeding sector there is confidence that private breeding adequately meets the needs of the market (with the State reducing some of the costs of breeding rather than posing further competition). Also, where market intervention is undertaken there is no government funding; thus any longer-term distortion is avoided. The result is an industry fully equipped by developing markets and meeting their requirements to compete in world seed potato markets.

The seed potato sector of Great Britain is principally concentrated in Scotland. The sector is going through a period of transition, as varieties subject to plant breeders' rights become more important. The State has played an important role historically, either by producing new genotypes, or in imposing seed potato regulations. In recent years the industry itself has recognized the need to take initiatives to develop more industry participation in such activities as quality control and intervention. These seem to be developed on a more ad hoc basis than in the Netherlands where there is the institutional cohesiveness for all sectors and the State to co-exist rather more constructively and coherently.

The seed potato sector is subject to considerable risk, and the way the sector modifies the assumption of risk is important. If the industry is too sheltered from risk then it will become complacent; if it is too exposed to risk, then many essential initiatives are unlikely to be taken. The balance is critical. In the UK system, many have been unwilling to assume risks because of the lack of incentive. The State ownership of varieties and the agency arrangements negotiated have not been sufficient to initiate the necessary intensive activity in overseas markets to get varieties on National Lists and to develop their sales. In the Canadian system similar problems arise, although here they are made even more acute by the absence of plant breeders' rights legislation. No Canadian exporter is going to spend money promoting a new variety unless he has exclusive rights to that variety. Also, within the Canadian industry there is often a very high gearing of producers to the returns from the potato crop (in some cases with virtually no other alternative farm enterprise) and in this case the consideration of the balance of risk represents an important political consideration.

It is clear from this report that the institutional arrangements for seed potato systems have an important effect on the nature of the seed industries. This is particularly important in the seed potato sector where there is a substantial element of service involved in the trade. The market is not a commodity market and success in terms of efficiency of production needs to be complemented by the effectiveness of the entire system in meeting both short and longer term market requirements.

1. Background

This study is an integral part of a wider investigation being undertaken by the International Potato Center to examine seed potato systems. The essential aim of the study is to assess why seed potato systems have the character that they have and to analyze their strengths and weaknesses. This report focuses on seed potato systems in developed countries and its aim is to provide an account of their nature and characteristics and the factors influencing their development.

It would be an ideal conclusion to this study if a developed-country seed potato-system model could be developed. However at the outset of this project it was recognized that because of the influence of so many diverse factors on the development of a seed system, no single developed country model exists. Therefore, the decision was made to select some case studies for detailed analysis to assist in the understanding of the nature of the production and marketing systems, rather than to attempt generalization across a diverse population. It follows from this that it would not be possible to select case-studies by any strict criterion of representativeness.

We have chosen as case studies three countries: The Netherlands, Great Britain and Canada. The seed potato sectors in these three countries have been subject to different physical, historical, commercial and institutional influences and, as a result, have widely diverging characters. However, there are also some similarities. These derive principally from the market context in which the seed systems operate. As mature seed systems they face a substantial challenge in increasing the sales of certified seed both within their own national borders and to markets in other developed countries. The fact that potato consumption is not increasing, combined with increasing farm productivity, results in a continuous reduction in the potato area and, hence, a lower total demand for seed. In these circumstances, international competitiveness has become a key issue as each of these seed producing countries

fight for markets at home and abroad. The impact of various seed potato program measures on competitiveness therefore is a recurrent theme in this report.

The report considers in very broad terms the nature of seed potato systems and the problems of evaluating them. It then gives a broad description of the potato sectors of the three countries and a detailed account of the seed potato system arranged under a number of key headings:

- General
- Trade
- Organization
- Phytosanitary and related issues
- Potato breeding and new variety development
- Release of material into the certification system
- Market support and regulation
- Promotion
- Other support activities.

Finally a broad assessment of the strengths and weaknesses of the different systems is brought into a final concluding section.

2. What is a Seed Potato System?

We are concerned with the production of seed material which, because of the formal procedures adopted, has a better disease-free status than that which would normally be available. In the countries we are examining, the bulk of the seed produced is derived from formal certification programs and production of seed outside the formal schemes is very limited. Informal potato seed systems do not exist in the countries we examined. When formal seed programs involving seed certification were introduced, it was recognized that they could not exist alongside informal methods. Consequently, legislation was introduced to empower single agencies to undertake all the certification. This was accompanied by regulations to prohibit either the use or sale of uncertified seed. Procedures to enforce these regulations were sufficient to virtually eliminate any of the informal arrangements.

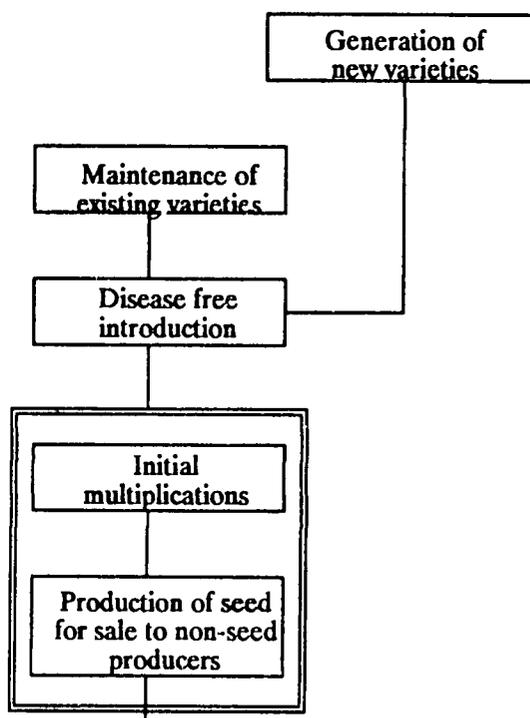
At the outset, it is necessary to distinguish between seed potato systems and seed programs. The principal focus of this report is the seed potato system which comprises all the individual activities and support services needed to produce seed potatoes in the countries examined. These various activities can be initiatives undertaken by the industry itself or by central authorities. A seed program is something much more specific and represents a set of measures introduced to improve the functioning of part of a seed potato system. For example this might be the introduction of disease-free stocks and a certification program or measures to improve the husbandry of high grade stocks. A program is normally funded by government or agency funds, and is devised for the benefit of the entire sector.

The seed potato system can be described in terms of the following separate 'core' processes (Figure 1).

Of particular importance is the information flow in the seed potato system. It is vitally important that decisions be made in the system on the basis of good and sound information on both market and technical developments. The

market information flows tend to be more of an institutional challenge than those concerned with technical issues. The latter are often easily described, assessed and involve extension to a clearly identified target audience. Also, the institutional development of scientific and technical discovery has initiated an infrastructure albeit flawed in certain respects, to cope with the 'extension' challenge of public and private research. On the other hand, information flows on developments in markets are not easily accommodated because (a) the information flows have in many cases to pass through several links in the distribution chain, often involving public and private sector organizations and (b) there is a substantial time lag between the activities at the top of the chain and the eventual sale of seed. Overcoming these two factors poses a major challenge for a seed potato system.

Figure 1. The "core" process in a seed potato system



Seed Potato Systems in Developed Countries: Canada, The Netherlands and Great Britain

Table 1. Essential support activities

Process activity	Support activity
+ generation of new varieties	Research, disease testing etc., variety testing and assessment (DUS & VCU), PBR registration, market information
+ maintenance of existing varieties	Disease testing
+ "disease-free" introduction	Disease testing, quarantine arrangements, accreditation of disease-free sources, market information
+ initial multiplications	Seed certification, disease testing, research and extension, crop insurance, credit, market regulation, marketing (market research, etc.), international representation (plant health, PBR and other statutory responsibilities) variety testing of VCU
+ production of seed for sale to non-seed producers	

DUS Distinctness, uniformity and stability

VCU Value in cultivation and use

PBR Plant breeder's rights

in the operation of the seed system is rarely effective without the assistance of legislation.

The interrelationships between the various core process and support activities are discussed in Gregg et al. (1980). There is a division of responsibility between the public and private sectors in conducting these activities although, as will be seen, this division varies in different countries as a result of the general historical and cultural factors and current circumstances.

The seed potato system interfaces with many other sectors. In economic terms the most critical interfaces are in the table and processing potato sector which it serves. Clearly, changes in the character of this sector can have a direct impact on the seed sector. These are also important economic relationships with other activities which compete for land in the main seed producing areas. There may be other agricultural enterprises or land use such as for tourism which are more attractive than seed potato production. Any consideration of the economic position of the seed potato sector must acknowledge these relationships.

While our central concern is the seed potato system and its wide range of components, a specific area of interest is intervention in the seed system in order to improve its functioning. Intervention is normally by government, although it may involve others working on a co-operative basis. Non-governmental intervention

3. The Overall Rationale for Intervention in the Seed System

In considering intervention in the seed potato system, we are not just concerned with the administration of a seed certification program, although this is of course a central focus. Government and public authorities intervene through a wide range of measures and for a number of reasons. They may undertake the various support activities mentioned above or even carry out some of the main process activities. They will also be concerned with the legislative framework for various aspects of the seed potato system. At the core of the legal framework lies the regulations for seed certification but, in addition, there may be laws covering plant quarantine, plant breeders' rights, seed testing and various aspects of commercializing seed.

There are several reasons for government intervention in the seed potato system and these will be discussed. First, the rationale of initiating formal seed certification programs is based on a technical premise. The vulnerability of the potato to a wide range of different diseases and pests is well known, and it is fully appreciated that many of these diseases are carried forward through successive generations in the tubers saved for seed. Thus any efforts spent in improving the plant health status of earlier generations results in lower disease incidence and higher vigor (and therefore benefits) in the progeny grown eventually for human consumption. Certification also facilitates the maintenance of varietal purity and pedigree so crucial in cultivation and use. Therefore, in promoting a formal seed program a government is pursuing sectorial development aims. Sectorial development objectives can be the justification of a wide range of measures of general support to the seed potato sector.

The rationale of the developmental argument is that measures to support the seed potato sector are achieved by improving the efficiency of production by (a) reducing the cost of seed production, and/or, (b) increasing the value of seed output. Any increases in efficiency can be passed on to the table stock producers and also to their users in improved prices or qualities. If these theoretical benefits are achieved, the taxpayer, who funds the subventions, receives some benefits from the improved performance of the production and marketing chain as a whole, and hence of the national economy.

It is possible to distinguish between measures which attempt to develop the seed sector as opposed to the domestic table and processing potato sector which it serves. In fact, there may arise some conflict here as the pursuance of the "developmental" rationale for the seed potato sector need not always assist the development of the table potato sector. This is particularly evident when seed potato markets are not closed. For example, efforts to develop the export competitiveness of seed potato sectors could result in the development of export demand for varieties which are normally destined for the home market. On a short term basis, (or where demand is very volatile and can only be met by opportunist sales) this could result in higher prices for the home table potato sector. For example, in the UK, prices of Desiree seed will be influenced by the export demand for this variety in North Africa. Similarly, quality standards imposed to meet the requirement of export markets may result in higher seed costs on the domestic market as a result of the additional costs of meeting these standards.

However, sectorial development is not the only reason for governments intervening in seed potato systems. They may also introduce

measures for social or equity reasons and for user protection. The social or equity argument may be based on the need to adjust the levels of income of seed producers or the principal users, table and processing potato growers. In this case, the subsidization of services will involve transfers from taxpayers to these groups. This is the basis of much support to developed country agriculture. Other transfers may also be encouraged such as between high grade and low grade seed growers or between all seed growers and their customers, or taxpayers and potato consumers.

The buyer protection rationale is necessary because, as with other seeds, the plant health status of the seed potato tuber is not obvious in the purchased seed. If a seed certification program is in operation, the quality of the seed a table or processing potato producer buys will have been subject to testing, control and classification during production, and he will have a much better idea of its quality. Thus the seed certification system can improve the transparency of the market with all the benefits that entails.

There may be a direct conflict between developmental activities which promote the development of an "efficient" sector and the social objectives. Promotion of production efficiency invariably demands adjustment in the structure of production, and those who most require social assistance are less likely to be able to compete. This is a common conflict in the agricultural policies of all developed countries in the world and is not an exclusive challenge of the seed potato industry policies.

It follows from the above that a key issue to be confronted is: "to whose benefit should programs be devised?" Douglas (1980) begins a book which he edited on successful seed programs with the following quote:

"A seed programme must be understood for what it is - a 'service' to farmers. The world's farmers, not governments nor private companies, produce the food for all consumers. Seed programmes fulfill their service function only when millions of farmers are able to obtain and plant better seed."

This statement is difficult to accept as a starting point. Its main deficiencies are that it does not refer directly to the consumers of

potatoes and neither does it confront the issue of which farmers are to be serviced. While the central objective should be the production of an important agricultural input which is efficient in use, the needs of consumers should also be considered. For example, the subsidization of certain parts of a seed potato system could result in distortions which might not be to the overall benefit of consumers on a longer term basis as they may prevent the adjustment of the production sector from taking place.

The issue of identifying who should be the target of benefits of seed potato programs is a central issue within all programs because, as we have indicated above, by distorting markets there is the possibility of influencing the distribution of benefits among the various groups concerned. The issue is being made all the more relevant by changes in technology which demand adjustment in the seed multiplication system. For example, the use of micro-propagation shortens the multiplication chain and means that some of the initial bulking up is done in vitro rather than in the field. Any attempt to resist this development to cushion the impact on initial multipliers will prevent the benefits of this technology from being passed down to table producers and consumers alike.

Below we list some of the possible means which can be used to pursue either of the objectives mentioned above through government measures in the seed potato sector (Table 2). As will be seen, each of these has some place in the potato system of the three countries investigated.

Table 2. Mechanisms of intervention

-
1. Subsidization of the cost of breeding:
 - a. Research
 - b. Fundamental breeding
 - c. Commercial breeding
 - d. Selection & testing
 2. Control over the volume entering the multiplication chain
 - a. By quantitative control of disease-free seed
 - b. Pricing policy
 - i. Cost of initial disease-free material
 3. Control over participants in the seed system
 - a. Who will be "elite" growers
 - b. Who will be the seed growers
 - c. Who will act as agents for state owned varieties
 4. Control over the cost of seed
 - a. Setting royalty rates for state-bred varieties
 5. Control over the relationship between different stages in the multiplication process
 - a. Selling-on costs
 6. Introduction of plant health controls
 7. Subsidization of the cost of supplying disease-free initial stocks
 8. Subsidization of the costs of seed multiplication
 - a. Research costs
 - b. Extension costs
 - c. Inspection and sealing costs
 - d. Marketing costs
 - e. Other costs of production for seed
 - f. Provision of credit and insurance
 9. Legislation to adjust institutional framework
 - a. Assist market organization
 - i. powers to raise taxes
 - ii. powers to impose disciplines
 10. Legislation for PBR
 11. Legislation for seed certification
 - a. Setting the level of standards
 12. Subsidization of use of potato seed
 13. General subsidization of the table potato sector
 14. Other general subsidies
 - a. Remoteness from market subsidies
 - b. Regional development assistance
-

4. The Technical Premise

Seed potato quality is defined in terms of the performance of the seed in producing a good quality potato crop with the highest possible efficiency. This means that to produce quality crops of seed potatoes consideration needs to be given to plant type, varietal purity, plant physiology and health. Each of these are important but it is plant health which attracts most attention because of its obvious economic effect. There are various ways to tackle diseases in potatoes. One way is by roguing out unhealthy plants and allowing the remainder to grow on with the assistance of other remedial measures. However in this method, disease soon builds up and initial stocks will need to be renewed. An alternative approach is to select out good plants, treat them separately, and use them as elite material from which successive generations can be produced. This latter method is referred to as clonal selection and has been the basis of seed multiplication and certification systems for many years. While it will not avoid disease, it can be effective as a means of controlling those diseases with latent infection such as potato virus X and S (PVX, PVS), mild mosaic, blackleg, skin spot, and certain other tuber diseases.

The first stage of clonal selection is therefore the preparation of disease-free material. Some varieties have a high resistance to virus and this has led to tested mother plants being used directly as the basis of seed multiplications. However, some varieties are susceptible to virus diseases and therefore they needed to be cleaned up by using *in vitro* propagating techniques (now generally referred to as micropropagation). This involves propagating the growing tip of plants (which have very low concentrations of virus) *in vitro* to obtain virus-free plantlets. In fact, this latter procedure also results in plantlets which are free from tuber diseases and consequently, with the development of an efficient and reliable micropropagation technique, this technique has become the starting point of many seed multiplication systems. Prior to this, some countries used

virus-tested stem cuttings, as the initial source of disease-free material to reduce levels of virus and tuber diseases. The procedures for initiating disease-free seed are supplemented by arrangements for inspections of the crop during the growing season, the product before sale, and by disease testing at various stages. This is the basis of formal seed certification schemes.

While it is common to hear the phrase disease-free or virus-free, these descriptions are not strictly accurate as there is some evidence that even micropropagation cannot completely rid plants of all traces of diseases. However, the levels of disease are substantially reduced and the designation "disease-free" for the products of this technique will be used in this report while recognizing its weakness.

On the purely technical level, the improvement of the plant health status of potatoes as a result of the implementation of formal seed production systems which incorporate certification, is relatively easy to illustrate, although proof is difficult because of the intervention of a wide range of factors. Yields in many countries depict a continuous increase (see for example Appendix 1 Table 3), but it is difficult to unravel whether this has been caused by improved seed, or new genotypes, or better husbandry practices (chitting, soil preparation, herbicides, pesticides, etc.). Acceptance of the benefits of improved seed is so much accepted on *a priori* grounds that there are now few specific tests to check these benefits. While the virtue of seed certification is widely accepted there is still some controversy over the level of standards set for certification.

This is still an issue in North America and we encountered it in Canada. The argument put forward was that the introduction of procedures to reduce the infection of potatoes with certain diseases (specifically the latent virus diseases) had reduced the ability of the plants to withstand certain other environmental pressures. This argument was the same as that encountered in the United States and discussed in detail by Shepard and Claffin (1975).

Seed Potato Systems in Developed Countries: Canada, The Netherlands and Great Britain

The introduction of procedures to clean up seed tubers for the so-called latent viruses (such as PVX and PVS, which do not produce consistent foliar or tuber symptoms) has been a standard basis of seed programs in Europe for a quarter of a century. The concept arrived later in Canada, and the introduction of the new in vitro techniques of propagation following exhaustive disease testing has considerably improved the situation, so that the Canadian program can justifiably be called "virus-free." The concept was resisted in many parts of North America, particularly in the United States. The reason was doubt over whether increased yields could be released when virus-free status was attained, and concern over the rate of re-infection.

But the main basis of concern encountered in Canada could be included in Shepard and Claffin's category of "old wives tales" and unsubstantiated findings. These are varied and included for example, the argument that the relatively mild infections of PVX found in North America are preferable to the more virulent strains which attack when re-infection of disease-free potatoes occurs. Also, it is claimed that PVX free potatoes are more susceptible to other diseases (e.g. potato leaf

roll virus) and that other effects are experienced (e.g. more pressure bruising in storage because of changes in physiology).

Because of the interference of many other intervening factors (particularly environmental factors) it has proved difficult to verify the yield effect in a North American context, although it is now largely accepted by the scientific community that virus X has an effect; but the conclusions in relation to virus S is less clear-cut. It is also accepted that procedures to eliminate virus X also indirectly reduce other diseases (e.g. *Erwinia atroseptica*).

Despite the lack of any scientific basis, it is strongly believed in some quarters in the Canadian seed potato system that certification standards are set too high and include diseases (e.g. the latent viruses) which have only insignificant impact. The complaint was made that while Canadian virus problems were not as serious as those of Europe, Canada was applying similar certification standards. Again the complaint was disputed, although this time the argument involved commercial as well as technical issues. In practice, when selling into export

markets, it is very important to take account of the requirements of those markets even if they are difficult to justify on an economic basis. High standards can greatly enhance the status of an exporting country and can represent an important feature when marketing the merits of its system. While this argument clearly has some validity, it is difficult for seed producers in areas such as New Brunswick to accept it. They now export very little outside North America and rely to a large extent on sales in the US where standards are less onerous.

5. How Does One Measure Performance?

The above discussion leads us to consider how one might assess the relative performance of a particular seed potato system. A major conclusion of the discussion above is that it is not satisfactory to assess the success of seed potato systems simply on the basis of the contribution to technical improvement and sectorial development. A sector may perform badly on some conventional criteria, yet meet all the objectives set for it, or, on the other hand, it may perform well on technical criteria yet not meet all the social or equity objectives set for it. How then does one measure performance? Clearly, on the basis of the above, it is unsafe to assess success without detailed consideration of the objectives of a particular seed program. Any more general appraisal of seed systems must take a multi-dimensional approach and any quantitative measures must be used with extreme care.

In physical terms, yield may indicate improvement in a technical sense, but the specific contribution of the seed program is difficult to isolate; any comparisons of yield or improvement in yield between different countries are bedeviled by the effect of other factors and the different resource-bases of the seed sectors being compared. Similar problems beset an assessment of improvements resulting from reductions in the incidence of disease. There are many examples of the incidence of disease being dramatically reduced (e.g. potato spindle tuber virus (PSTV) in Canada) although it is difficult to tie this in conclusively with overall yield improvement in table potato production. Horton et al (1987), in a study of the impact of the Korean Seed Potato Program assume that 50% of yield improvement comes from the program. Such generalizations would be dangerous in the case studies used in this study given, for example, the dynamic nature of the structure of potato production, potato husbandry practices, and genotype, and the fact that formal seed certification systems have been in place for many years.

However, improvements in physical terms may not necessarily mean greater financial

performance and economic considerations should also be taken into account. In financial terms, the preferred economists' criteria would be the financial return on the investment. However, it is more appropriate to apply these criteria to project investment than to a general program of legislation. While with some amendment financial return criteria can be adapted to assess a program there are very substantial problems of data availability and measurement involved, and because inter-country comparisons are fraught with many difficulties not least of which is coping with exchange-rate variations.

There are strong reasons for using price as a proxy for comparative efficiency, although again comparisons are bedeviled by factors which are completely independent of the seed potato sector. Also, there are clearly difficulties in using price because of the distortions which arise from the subsidies which are part of the seed potato systems of many countries and the fluctuations arising from the variations in annual supply. Price can also be a misleading criterion in the seed potato sector because of the very substantial differences in quality associated with the product. For comparative purposes one would need to be comparing similar varieties with similar disease status and characteristics. In fact, even then, there may be difficulties because the product being sold is not just the intrinsic quality of the potato but also a significant service element. Thus the Dutch seed industry is likely to be able to sell the same product at a higher price because it is a known source of supply and because of the nature of the after-sales service (extension, trials support, promotion, etc.). In any case, there are no adequate price series which provide either a good indication of the development of seed potato prices or of the comparative level of prices available in any of the countries which we have studied. Appendix 1, Tables 4, 5, and 6 provide price series for table potatoes. They are presented to illustrate that even if seed potato prices were collected it would be difficult to

draw conclusions from them. The data refer to table potatoes of different qualities, as the standards and varieties vary between countries. Also, although they are producer prices they include different elements of service. In the Netherlands all grading is done off the farm whereas in the UK a large part of the crop is graded and packed on the farm. Even when prices are converted into a common currency (Table 6) care must be taken. UK prices are invariably higher than Dutch prices, but only because of the existence of market regulation, and not necessarily because of efficiency (although there is a strong theoretical case that price and deficiency are related).

We conclude that there is no simple way of assessing and comparing seed potato systems. Perhaps the best composite of all these factors is simply the long-term development of the volume and market share of the seed system. This will provide some indication of the extent to which the seed-producing country has been able to develop its markets, although it does not overcome the problems mentioned above.

A major difficulty here is the nature of the market for seed potatoes. Any individual country could be quite seriously handicapped by barriers to trade such as plant health restrictions. While it could be said that a good system would have introduced the necessary precautions to have overcome any major disease problem, this is as rather a harsh judgement as diseases are often unpredictable, and chance introduction could occur in any system no matter what the precautions taken. Also, it will be obvious that an increase in market share does not necessarily mean that a particular system is good. As we have seen above, it is possible to intervene at many points in the seed system, and these interventions might help develop market share but at high economic costs, and at the expense of all criteria of economic efficiency.

Because increasing the market share is such an important and recurring theme in developed-country, seed potato systems, we use this theme to provide a framework for analysis within which we can pose questions about the nature of competitiveness in the seed potato market (see Table 3). The conclusions are that, if we ignore certain macroeconomic factors which affect the macroeconomic situation, the competitiveness of the seed potato sector is

determined by having the right resources, an efficient production sector, and an institutional framework which encourages market orientation. This study will focus closely on the latter as it represents the basis of seed potato policy.

Therefore, we are left with a rather unsatisfactory and incomplete list of criteria for measuring the performance of seed potato systems. We conclude that one has to rely, to a large extent, upon a qualitative appraisal, based upon a model of what the requirements of a successful seed potato system might be. It is suggested that the most appropriate model is one which has features which allow the sector to have all the information necessary to fully understand the needs of the customers and the basic structure of production and support activities to ensure that the core seed-production activities can produce the final product as efficiently as possible.

Table 3. Successful seed potato systems

1. What constitutes good performance?	An increase in market share
2. Why are seed potato sectors successful in developing market share?	Because they can supply the product competitively
3. What constitutes competitiveness?	The product which is the best value for money
4. What constitutes the best value for money?	This can be considered on three dimensions, each of which are interrelated: intrinsic quality; service; and price
4.1 What constitutes inherent quality?	Principally the genotype (and all that implies in terms of yield potential, disease resistance, skin color, shape and other characteristics), physiological status and the disease status of the tuber
4.2 What constitutes service?	A wide range of factors: size-grading, risk reduction, presentation, packing, transport, advice on use, availability, perceived quality, etc.
4.3 What constitutes price?	Price is a function of the level of demand and supply. The supply side is principally influenced by the efficiency of production and degree of government subsidization
5. How are quality, price, and service achieved?	There are three main components: natural resources; good management and husbandry; and an appropriate institutional framework
5.1 What constitutes the necessary natural resources?	Essentially, an environment which is not conducive to virus (low aphid population), tuber disease (clean soils & absence of pathogens), or pests and soils and climate which favor a high yield response and sound tubers
5.2 What constitutes the necessary management and husbandry?	Essentially, the selection of seed, planting, cultivations, application of inputs, harvest, post-harvest treatment, and storage to produce the combination of quality and output to maximize return
5.3 What constitutes the necessary institutional framework?	Essentially, the mechanisms to ensure that varieties with the appropriate health status and other qualities are produced to meet market requirements, and that their availability is promoted and the means of adequately servicing customers with these potatoes is provided

6. Background to the Canadian Potato Industry

Production, Areas, and Yields

Canadian potato production was recorded at 3.03 million tons in 1985. On the basis of FAO estimates this ranks Canada about seventeenth in the world. Of the 3.03 million tons of potato production in Canada in 1985, 27% originated from Prince Edward Island (PEI) and 23% from New Brunswick. The other important areas are Quebec (15%), Ontario (12%), and Manitoba (11%). In total there are 7,100 farms reported to be producing potatoes with an average area of 17 ha. The farms tend to be larger in PEI and New Brunswick.

While potato production is variable on a year to year basis, a steady upward expansion can be observed (Appendix 1, Table 1). As is true of many other potato economies, a typical rise and fall in production is related to prices in previous years. Potato area has fluctuated quite significantly, especially up until 1975 although since that date, in every year with the exception of 1985, fluctuations have been less dramatic and a slight increase has been observed (Appendix 1, Table 2). The major reason for this has been reduced returns for a number of competing crops, in particular a decline in the profitability of tobacco production in some of the potato areas.

The adoption of irrigation, new varieties, and generally all round improved management have led to a gradual increase in yields so that they now average at between 24 to 25 t/ha (Appendix 1, Table 3). Yields are highest in PEI and British Columbia (around 28 to 29 t/ha).

The greatest increase in production has occurred in PEI and Manitoba (although in the latter from a very small base). In PEI the increase from 1980 to 1985 has been approximately 31%.

Varieties

A wide range of varieties of potatoes are grown for the table market but the variety Russet Burbank has persistently gained in importance. This variety represented 37% of the seed potatoes' area in 1986. Its relative importance has grown steadily, accounting for less than 20% before 1977. The other important varieties, as indicated by seed production, are Kennebec (20% in 1985 and declining) and Superior (12% in 1985 and increasing) (Appendix 1, Table 16). Generally the requirement for the table market is for a large sized evenly graded potato and this has prompted the selection of varieties which produce a relatively small number of tubers of quite large size. There is no formal variety labelling in either the Canadian or United States markets and this has encouraged the development of varieties which meet certain broad type characteristics, e.g. long oval, round white, or colored. Some yellow fleshed varieties such as Bintje and Yukon Gold are sold by name, and in the United States Russet Burbank and Yukon Gold have been marketed using the trade names Idaho Baker and Michigan Golden Bake respectively.

The Importance of Potato Production

Potatoes represent roughly 1.5% of total farm cash receipts for the whole of Canada although the importance of potatoes is much higher in PEI (usually between 30% and 40%) and New Brunswick (usually between 20% and 30%).

Consumption

It was estimated that in 1985 the annual per capita consumption of potatoes in Canada was 68 kg. Consumption has remained at or around this level for the last twenty years.

Utilization

On the basis of estimates by the federal government, approximately 37% of total Canadian marketable potato production moves onto the table market, with 51% sold for processing, and 12% for use as seed. However, there are substantial differences between the provinces in this respect. In PEI and New Brunswick the relative importance of the seed crop has averaged 36% and 26% respectively over the five years 1981 to 1986. Over these years, New Brunswick and PEI have accounted for 62% of the total volume of seed production used as seed in Canada, but 85% of all certified seed potatoes.

Trade

Canada has an important export trade of ware, seed, and processed potatoes to the United States, and also exports seed and processed products to non-North American destinations (Appendix 1, Table 7). It also imports from the United States potatoes from each of these categories, although Canadian trade with the United States has a positive net balance in each category.

The Canadian potato industry has the facilities to supply potatoes all year round, although during the period April to July there are imports of new season potatoes from the United States, and also stored potatoes which meet specific quality requirements. The pattern of trade which has developed with the United States has entailed the Maritime Provinces (principally PEI and New Brunswick) becoming important suppliers of the east coast of the United States both for seed and for table markets. In addition, British Columbia and Alberta have increased their exports of seed potatoes into the West Coast. Trade flows in

the other direction from the United States to Canada enter into most provinces during the late and very early part of the North American potato season. There is a strong flow into the prairie provinces from major table and processing potato production areas in the north-west of the United States.

Seed potato trade between Canada and the United States has been a politically sensitive issue, and disputes frequently arise. At the time of writing this report both United States and Canadian tariffs had been harmonized at \$7.71 per ton. Up to 1979 a quota of 50,000 tons was imposed and exports in excess of this incurred higher tariffs. Because of the widespread practice of selling seed for use as table stock, this system proved very difficult to police until the United States introduced requirements that all imports had to be accompanied by an end-use declaration in 1982.

Prices

There has been substantial volatility in potato prices which has led to consistent calls for attempt to regulate the market. Canadian potato prices are heavily dependent upon market conditions and circumstances in the United States and to a lesser extent those in Europe. Since 1976 prices have varied from 8.7 to 16.1 cents per kg in nominal terms (Appendix 1, Table 4). The federal Department of Agriculture has undertaken research which has demonstrated this relationship, although they acknowledge that further studies need to be undertaken in order to confirm it. They show that if the United States has a large output and prices below those of a year earlier, Canada will have lower prices even if supplies are not unusually large. Where the United States has a short supply and prices well above those of the previous year, Canada will have high prices even if the crop in Canada is average or above. Generally, when prices are low, Canadian potatoes have to be sold at below the United States price in order to gain a foothold in the market. However, when prices are high, Canadian potatoes appear to be able to demand a premium in the United States market. In other situations the Canadian prices are much more clearly influenced by local conditions. When the crop in Canada is very

short, prices will be above the previous years levels even if United States prices are below their previous year levels. However, the fact that United States potatoes will be at very low prices will limit the extent to which prices can increase in Canada. The ability of the Canadian industry to compete therefore depends, greatly on the extent to which its raw product prices respond to market conditions in the United States. These relationships with the United States market are a vitally important feature of the Canadian potato marketing system and have an important influence on many potato policy considerations.

The market situation in Europe has only a very small effect on the Canadian industry. In years of very high short supply in Europe there have been modest trade flows from Canada. While historically there have been flows of seed potatoes to Europe, these have come under increasing pressure as the European Community has expanded and new members have adopted the phytosanitary restrictions (specifically those pertaining to bacterial ring rot, *corynebacterium sepedonicum* (BRR)) applied at importation into the EC.

The Processing Sector

The Canadian processing industry utilizes some one million tons per annum, with about half being used for french fries and slightly less than half for potato chips. The remainder are processed to produce dehydrated products and various other fresh products. The frozen french fries industry is largely concentrated in (by order of importance) New Brunswick, Manitoba, PEI, and Alberta. Russet Burbank is the preferred variety for french fries, although in recent years Shepody has rapidly gained importance, particularly in those areas which are supplying McCains, a major french fries processor. The potato chip industry is concentrated closer to markets, and particularly in Ontario and Quebec. Here the preferred variety is Norchip, with Monona and Atlantic also being used. Some 46,000 tons of frozen french fries are exported from Canada to a wide range of destinations of which the United States, Japan, Puerto Rico, and Trinidad/Tobago are the largest markets.

Market Infrastructure

In the principal production areas many producers have developed their own marketing operations. Many of these producer/shippers handle seed, table stock, and potatoes for processing. As noted above it is a frequent practice for potatoes to be grown to meet seed standards, and then size graded for use in different markets. In the major production areas the french fries companies represent important customers. This sector is highly concentrated with production dominated by very few companies.

Market Regulation

Marketing boards, agencies, or commissions exist in all provinces and carry out a number of functions such as promotion, administration of federal programs of assistance to potato growers, or representing the interests of the provincial potato industries at various levels. In addition, these organizations are involved in the negotiation of contracts with potato processors and in certain provinces, also attempt to regulate the minimum prices at which potatoes can be sold.

Each of the provincial potato boards are autonomous, and the nature of their organization and function varies considerably from province to province.

Within this last year there has been a major attempt to launch a federal potato agency which would attempt to regulate production by means of quotas in each province. In very broad terms the system proposed is that each province would have a market share allocated to it in each of the principal potato markets. They would only be allowed to sell up to the limit of that quota and potatoes in excess of this would have to be disposed of, using funds from a variety of different sources, but mainly from the industry itself. Implicit in the organization of the proposed regulations is the control of imports from the United States negotiated on the basis of concession to restrict the export of Canadian potatoes to the United States.

7. The Canadian Seed Potato System

General

The total Canadian certified seed potato production in 1985 was estimated at 871,000 tons by Agriculture Canada. However, of this total, it is estimated that only 330,000-350,000 tons (roughly 35 to 40%) was actually marketed as seed potatoes. The reason for this discrepancy is that in one of the principal seed production areas, PEI, the entire potato crop is subject to certification to ensure that high quality standards are maintained throughout the whole industry. In addition, this practice allows greater flexibility in marketing as the entire field crop can be sorted and sized according to the market requirements in any given season. In 1985 PEI had a seed crop of 540,000 tons of which only 118,000 tons (22%) were sold as seed. The same pattern occurs in New Brunswick although to a lesser extent, with 47% of the 204,000 tons of the 1985 seed crop being sold as seed. Estimates of seed sales in other provinces suggest that this practice is much less common. Later sections of this report will focus on the functioning of the seed potato system in these two provinces in some detail, and describe the separate federal and provincial regulations which bring about the above situation.

From estimates made by the author it would appear that certified seed is widely used by potato growers. Part of the explanation for this is the legal obligation to plant certified seed in the main seed potato growing areas, which together account for a large proportion of the total area. The basis of our estimate is outlined in the following table for 1985.

Greater detail on the calculation of these and comparable figures for the UK and The Netherlands is given in Appendix 2.

The seed rate is relatively low because of the widespread practice of cutting seed, and also because of the predominant demand for large-sized potatoes to meet both the table stock and domestic seed markets.

Table 4. Certified seed potato use. Canadian producers, 1985

Total area planted	122,000 ha
Average seed rate ^a	2.1 t/ha
Total seed requirement	257,000 tons
Actual certified seed used ^b	233,000 tons
Estimated per cent planted with certified seed ^c	91%

a Source: McGiffen, 1985 and checks on seed recorded as sold and area planted in those areas where certified seed is compulsory.

b Source: National Farm Products Marketing Council inquiry.

In general, the geographical position of the main Canadian seed potato production sector in the Maritime Provinces has had positive phytosanitary effects. The long, harsh cold winters have protected the seed potato crop from overwintering pests and diseases. Combined with ample water supply and ideal conditions for rapid plant growth in the summer months, the Maritime Provinces are a good location for seed potato production.

Seed Trade

Of the 330,000 to 350,000 tons sold as seed, between 90,000 and 150,000 tons have been exported in recent years. A large proportion of these seed exports (roughly one-third) is destined for the United States market; in PEI and New Brunswick this proportion is 15% and 50% respectively. The other major export markets include Venezuela and Cuba (each representing about 20% of exports), Uruguay (8%), and Italy (7%) (Appendix 1, Table 7). PEI supplies roughly 50% of all Canadian seed potato exports, selling principally to Uruguay, Venezuela, Italy, Portugal, Turkey, Greece, and Spain. New Brunswick is the other exporting seed potato province with the only important off-shore market being Cuba which refuses to buy from PEI for phytosanitary reasons.

A relatively small number of shippers are involved in servicing the off-shore (non-North American) export market. Most estimates

suggest that these are limited to six to eight companies.

The Canadian industry is subject to substantial competition in off-shore seed markets from The Netherlands, the United Kingdom, France, Germany, and others. In recent years they have lost some of their traditional market in the Southern EC countries because of the imposition of the phytosanitary requirements of the European Economic Community.

Only a very small quantity of seed potatoes are imported and these all originate in the United States.

Organization

Because of the constitutional position of Canada, the organization of the Canadian seed potato industry is relatively complex. While much of the central legislation concerned with plant health and seed certification is administered federally, there is an element of autonomy in relation to its implementation by the various provincial governments. This has meant that each provincial seed potato industry has developed in a different way. Provincial initiatives have added to and modified the way in which seed certification is imposed, and different structures have emerged for the maintenance of varieties, introduction of disease-free material, and seed multiplication. Also, there are a number of approaches to the organization of the various support functions noted earlier. Both provincial governments and the provincially constituted organizations for the potato sector have a major part to play in administering the seed potato sectors. The federal and provincial responsibilities and forms of organization are discussed in some detail in the sections below.

Federal Responsibilities and Organization

At the federal level, responsibilities for potatoes fall principally under the Food Products Inspection Branch of the Department of Agriculture (called Agriculture Canada). Another Branch has responsibility for the federal agricultural research program including potato research. The Research Branch is also

responsible for the federal potato breeding program. This is the only potato breeding undertaken within Canada. Within the Food Products Inspection Branch there are two departments which have responsibilities covering seed potatoes; the Seeds Division and the Plant Health Division.

Allocating responsibility for potatoes between these two divisions has been the subject of much debate within Agriculture Canada. At various times over the years, responsibility for seed potatoes has been moved from one department to the other. The central issue is whether the inspection services for potatoes should be subject to the same line management control as the inspection services for all other crops. The arguments for not following this path are that the seed potato program demands a substantial amount of backup in terms of technical services and it is, therefore, prudent to see that these are well integrated and coordinated. As these services are readily available in the Plant Health Department, it is in this division that all the potato certification and support activities have been placed, although this is a relatively recent adjustment in responsibilities.

In 1986, Agriculture Canada set up a National Seed Potato Bureau within the Plant Health Division with two separate sub-departments covering technical services and inspection. Within this department there is now a concentration of services dealing with the development of the certification program and regulations pertaining to seed potatoes within a single unit. The delivery of the seed certification program is the responsibility of the Agricultural Inspectorate Directorate. Thus, despite the change in positioning of responsibility for seed potatoes at the federal level there is by no means full autonomous control by the National Seed Potato Bureau over all seed potato activities. Within the provinces the seed potato line management with responsibility for the program have to call on inspection staff who have no immediate responsibility for delivery of the program.

The Seeds Division still has some responsibilities for potatoes in so far as it administers the national list scheme within Canada which incorporates potatoes. It is also the division with the responsibility for servicing the examination of

the alternatives for legislation for rights of plant breeders. This issue has a very long history in Canadian agriculture, and there have been various attempts to introduce plant breeders' rights over the years. On a number of occasions as a result of changes in parliamentary time-tabling draft legislation has failed to be introduced into Parliament. However the current Canadian government has a commitment to introduce plant breeders' rights and is understood to be examining with some urgency the introduction of a new bill. Most sections of the agricultural community, especially those within the seed potato industry, welcome the introduction of this legislation. However, it has encountered quite serious opposition from environmentalists and from a number of smaller representative groups concerned with agriculture. The draft legislation is understood to be modelled on the UK Plant Variety Rights Act.

Provincial Responsibilities and Organization

In Canada, roughly 85% of all seed potatoes are produced within the two provinces of New Brunswick and PEI. Consequently, this study is focused on the arrangements within these two important seed producing areas. Because of the significance of seed potato production, the arrangements which are in force in these two provinces are not representative of other Canadian provinces. A brief overview of the potato industries of these two provinces is presented at Appendix 3.

Before discussing the nature of the organization at the provincial level it is necessary to consider two relevant issues, the relationship between the provinces and the federal government and provincial rivalry in the potato sector.

a. **Federal assistance to the provinces.** The extent of federal assistance to the Maritime Provinces is quite considerable and it takes many forms. The concept of "cooperative federalism" has been accepted by successive federal governments, and this involves the transfer of substantial funds from the federal government to less well-off provinces. The federal program of Equalization attempts to compensate poorer provinces. There are other programs which also involve transfers. All of

the Maritime Provinces compare poorly with the rest of Canada on a number of economic criteria. The regions are remote from the main markets in the rest of Canada and suffer substantial disadvantage in terms of transport costs.

As an example of the independence of some of the provinces insofar as this assistance is concerned, on these aids, the PEI 1987 budget acknowledges that one half of provincial government revenues are derived from federal transfers. Attempts by the federal government to reduce the federal budget deficit has put pressure on all these transfers and is an issue of concern for the eastern Maritime Provinces. However, new initiatives announced in the summer of 1987 illustrate the continuing political commitment to encouraging the development of the Maritime areas.

Assistance to the potato industry represents just one of these measures and must be seen in the light of the initiatives taken at federal level to assist the Maritime Provinces. For example there are transport subsidies available for PEI and New Brunswick for the sale of potatoes into the rest of Canada. Also there is a very low level of cost recovery for some of the services associated with the seed potato sector. Federal assistance has been directed towards partial funding of program for the eradication of diseases and the development of an infrastructure to provide disease-free material at the apex of the seed multiplication system, and for disease testing. Ferry transport off of PEI is subsidized and the essential ice-breaking facilities required in the winter months to keep potato trade moving are also funded by the federal government.

These measures can be justified by the federal government as an attempt to exploit the comparative advantage for seed potato production in these regions. This comparative advantage in terms of local production conditions is challenged by the very substantial haulage charges into the main markets such as Ontario and Quebec, and the development of local seed and table potato production in these provinces. Despite this, the possibilities of the Maritime Provinces for selling into the North American market and also in consolidating its position in the off-shore export market, is seen as justification for continuing federal support of the sector.

b. **Provincial rivalry.** There is a very high degree of competition and rivalry between New Brunswick and PEI. This rivalry is such that it has frustrated attempts to initiate and sustain certain joint activities for the common good of both seed sectors. The different character and structure of the seed potato sectors in the two different provinces hinders collaboration. The fact that PEI is an island enables it to exert rather stronger disciplines on marketing than is feasible in New Brunswick with its many access points to the north east United States market, and also to other Canadian provinces.

As noted above, PEI has a much greater orientation than New Brunswick towards exports off-shore, and has a system whereby a large proportion of the potato area is entered for certification and all growers are obliged to grow some seed. In New Brunswick only seed crops are entered for certification. While the importance of the potato crop is high in PEI and the bulk of production comes from specialized growers, they are less dependent than the New Brunswick growers on the potato crop for income. Many New Brunswick potato growers have no other source of agricultural income and are very highly geared towards revenue from the potato crop.

The antipathy between the New Brunswick and PEI industry is apparent to the visitor at many stages. The biggest challenge arises when there are certain functions which need to be undertaken but which require joint funding because of their expense. Export promotion is one very good example, and lack of agreement between the two provinces on the funding of export development through the organization, Potatoes Canada has seriously affected the effectiveness of that organization.

The most recent form of competition is in getting access to imported varieties under license from plant breeders in other countries. The introduction of these new varieties could have an important effect on the shape and direction of seed potato industries in the two provinces. For the time being, the principal Dutch, British, and French breeders agents appear to have divided themselves fairly evenly between the two provinces. Most of the varieties being introduced are destined eventually for sale into the North American market if they should prove successful. Initially, the varieties

are being held under contract by the New Brunswick Potato Agency (NBPA) and the PEI Potato Marketing Board (PMB). This gives these organizations the responsibility for the maintenance and control of these varieties during the initial evaluation period. It is anticipated that the foreign breeders will wish to establish agencies to market these varieties and to contract multiplication with their own group of growers. This will give the foreign breeders the opportunity to select their own growers to work with so that they can be sure of reaching the necessary quality standards and maintaining adequate control over the use of the varieties. The first sign of this development has come in PEI where one of the major exporters has established a joint venture company with another exporter and a Dutch breeder's agent which will serve as the basis for a seed multiplication company.

Below we describe the basic organization activity of the seed potato sectors in these two provinces.

c. **Organization in PEI.** In PEI the most important institution concerned with the potato industry is the Potato Marketing Board. This organization was established under provincial legislation to improve the marketing of agricultural products in PEI. Specifically in relation to potatoes the objectives of the legislation were to:

- encourage the production and marketing of high quality potatoes;
- curtail the spread or development of serious potato diseases;
- eliminate unethical practices and prevent unnecessary costs in the marketing of potatoes;
- investigate and develop markets for PEI;
- improve transportation and other marketing facilities.

The PMB comprises nine members, all of whom are elected by producers but three of these must be members nominated by the dealers' association. The Board has very wide-ranging powers with respect to licensing, disease eradication, contract negotiation, promotion, transport-rate negotiation, and enforcement of orders in relation to pricing. It also administers any federal schemes for the potato industry such as the advance-payments scheme and stabilization or diversion programs. The PMB

also runs the Fox Island Elite seed farm (the source of disease-free material) and is responsible for the distribution of seed to the industry. It is therefore considered to be the fulcrum of the PEI seed industry. It is funded by compulsory levy (from growers and dealers), license fees, seed sales, and grants from the provincial and federal governments.

Although it is elected by growers it has a separate identity from the main growers' association and has, in the past, taken an independent view. A plebiscite in 1986 produced only a small majority in favor of maintaining the PMB and as a result a Royal Commission was established to review the operation of the PMB and the organization of the potato industry. The full findings of this Commission were not available at the time of writing this report, although it is understood that the status of the PMB will be changed.

The other main organization concerned with the PEI seed potato industry is the PEI Department of Agriculture. The Department provides a range of supporting functions for the seed potato sectors as well as some of the general agricultural sector infrastructure. Its principal role in the potato seed sector is in the area of extension. In addition, it is a participant in a number of programs which assist the battle against potato diseases, and particularly bacterial ring rot. This includes various responsibilities in conjunction with the PMB and federal authorities in relation to dealing with disease notifications, disinfection of all trucks entering the island and pallets used for sea transport, cull-disposal assistance, aphid and blight alert programs, and seed incentive schemes to help farmers who have a BRR outbreak to get back into production after the clean-up procedures have been followed.

The federal responsibilities have already been discussed in the previous section. The distribution of responsibilities among the different organizations for PEI is shown in Table 5.

d. Organization in NB. In New Brunswick the equivalent of the PMB is the NBPA. However, while it has wide powers, this organization plays a relatively limited role compared with its PEI equivalent. The Agency was set up under the New Brunswick Farm Products Marketing Act of 1983. The main aim of the establishment of the Agency under this

act is to provide for the promotion and control and regulation of the marketing of potatoes within the province of New Brunswick. The Agency is a producers organization and the ten directors of the Agency are elected from five potato growing districts in the province. New Brunswick is a bilingual province and representation comes from both the French and English speaking sections. This division has also led to the establishment of two separate offices to cover the two languages.

The Agency has very extensive powers to regulate the marketing of potatoes. These powers include: the possibility of establishing and administering a quota system, fixing of prices, the direction of sales, etc. In addition to the market regulation powers it has responsibility to undertake a number of general functions such as research, extension, education, promotion, liaison and coordination, and market information and representation. The legislation also formally establishes negotiating committees for the sale of potatoes to various processing destinations. The negotiating committees are empowered to adopt, or settle by agreement, prices and terms and conditions of sale with the processors. These negotiating committees will be comprised of six persons of which three will be appointed by the Agency and three appointed annually by processors. The Agency is funded principally by industry levy and license fees, although there may be some funding from the Department of Agriculture.

It will be clear from the above that the intention of the NBPA is that it should operate principally as a producer organization and not as a representative of the industry as a whole. In practice, in New Brunswick, most of the wholesaling activities are undertaken by producers and so their requirements are fairly well represented through the NBPA. However, there is no place in the Agency for the processors and indeed one of the major objectives of the Agency is to provide some countervailing power for producers in negotiation with the processors.

In practice, the NBPA uses very few of the powers available to it. Its principal areas of activity are the negotiation of processed potato contracts, the promotion of New Brunswick potatoes in other provinces and the United States, the licensing of growers and dealers, the

Seed Potato Systems in Developed Countries: Canada, The Netherlands and Great Britain

Table 5. The responsibility for different activities and functions in the Canadian seed potato system

Sectors	Agency with responsibility (implementing agency underlined)	
	New Brunswick	Prince Edward Island
<u>Main production activities</u>		
+ breeding	None	None
+ variety maintenance	NBDA(BA)	PMB(FI)
+ generation of initial disease-free material	NBDA(BA)	PMB(FI)
+ initial multiplication	NBDA(BA) (usually to EI)	PMB(FI) (usually to EII)
+ multiplication	25 elite growers (usually at EEI) and the 55 recommended seed growers	55 growers (usually at EEI) then several hundred of F and C seed growers
<u>Support activities</u>		
+ research	AC & <u>NBDA</u>	AC & <u>PEIDA</u>
+ extension	AC & NBDA	AC & PEIDA
+ credit facilities	AC & NBPA	AC & PMB
+ breeding	AC	AC
+ market support	AC	AC
+ crop insurance	AC & <u>NBDA</u>	AC & <u>PEIDA</u>
+ seed certification	AC	AC
+ disease eradication programs	<u>NBDA</u> , AC	AC, PEIDA, <u>PMB</u>
+ plant-health measures	AC	AC
+ aphid-alert scheme	NBSPGA	PEIDA
+ disinfection service	NBDA, NBPA, AC & NBSPGA	PEIDA
+ market information	NBDA	PMB
+ market development/promotion	AC, NBDA, <u>NBPA</u> , <u>PC</u>	AC, PEIDA, <u>PMB</u> , <u>PC</u>
+ variety evaluation	NBDA	PMB
+ capital funding for main central production activities	AC, NBDA	AC, PEIDA
<u>Market organization</u>		
+ producer licensing	NBPA	
+ dealer licensing	NBPA	
+ processor negotiation	NBPA	PMB
+ transport negotiation	NBPSA	PMB
+ terms of sale contracts		PMB
+ sales restrictions		PMB
+ quality control	NBDA, AC & NBPA	
<u>Policy</u>		
+ source of material	AC, NBDA	AC, PEIDA
+ lab/plant health procedures used	AC, NBDA	AC, PEIDA
+ allocation policy	Bon Accord Management Committee	PMB
+ importation policy	AC	AC
+ disease eradication	Potato disease committee and AC, NBPA and NBSPGA	PEI Plant disease committee and AC
PC	Potato Canada	
AC	Agriculture Canada	
PMB	Prince Edward Island Potato Marketing Board	
NBPA	New Brunswick Potato Agency	
NBDA	New Brunswick Department of Agriculture	
NBDA(BA)	New Brunswick Department of Agriculture (Bon Accord Seed Farm)	
PEIDA	Prince Edward Island Department of Agriculture	
PEIDA(FI)	Prince Edward Island Department of Agriculture (Fox Island Seed Farm)	
NBSPGA	New Brunswick Seed Potato Growers Association	
NBPSA	New Brunswick Potato Shippers Association	

administration of a federal credit program providing advance payments to potato growers, the administration of stabilization payments from federal sources when these are made, and participation in a wide range of different activities to develop the position of the sector in conjunction with the New Brunswick Department of Agriculture.

The New Brunswick Department of Agriculture is responsible for some of the important seed sector activities covered by the PMB. In particular it covers the maintenance of varieties and the introduction of disease-free material into the multiplication chain. In addition it is involved in research, extension, disease testing, promotion, and more general issues affecting the potato industry. This gives it a very key and central position in the seed potato sector.

Federal funding is also available for some of these activities as indicated in the sections above. It will be recalled that in each province the federal government has responsibility for certification services.

In both PEI and New Brunswick growers' associations play an important role. The New Brunswick Seed Potato Growers Association is directly involved in providing disinfection, aphid alert, and non-seed inspection services to the industry. In PEI their activities tend to be restricted to representation.

e. A summary of provincial responsibilities. The overall pattern of responsibilities in both provinces is shown in Table 4.

Clearly, because of the greater interprofessional influence in the PEI potato industry, it has a very different character from that of New Brunswick. The geographical position has also influenced what is attempted in terms of regulation and organization of the industry. Thus, because it is an island and its potato production is geographically concentrated, PEI has more alternatives available for imposing certain market disciplines. It is also easier to mobilize support for a central organization because the benefits of cooperation, collaboration, and discipline on an industry scale are more apparent. Thus, regulation is very much part of the potato market in PEI.

f. The provincial seed potato systems. The broad nature of the seed potato system is outlined below:

New Brunswick

The production of seed potato tends to be specialized, with seed planted for seed being utilized for seed.

The plant propagation unit for producing disease-free material is isolated from the Bon Accord Elite seed farm. Within this unit a program of disease testing is undertaken and the resulting disease-free plantlets sent to the Elite farm. Here on a three crop/yr basis, minitubers are produced. These are then planted out and multiplied to produce a crop of Pre-Elite seed. This seed is then made available to a special group of 25 Elite growers who undertake the multiplication of Elite seed. After multiplication for several generations these growers then sell to 72 recommended seed growers for production of lower classes of seed.

Under the disease eradication legislation, all potato growers must plant certified seed. Non-seed potato growers are subject to inspection by an inspection service organized by the Seed Potato Growers Association and funded by the NBDA.

Prince Edward Island

A large part of potato production is at certified standards although only a small proportion will be sold for seed.

Disease-free material is introduced by the PMB from in vitro methods on the Fox Island Elite seed farm. One screen house crop of minitubers is produced each year. These are multiplied through Pre-Elite, EI and EII certifications to be sold from the PMB Elite seed farm for EII production to a group of elite growers for further multiplication and sale. There is some production of EI and EII seed by specialist growers but only for varieties which are known not to be too difficult to handle.

Some Elite seed growers may maintain their own seed plots and can enter crops from these.

Under disease eradication legislation all potato growers must use certified seed and must enter at least 10% of their area for foundation seed classification.

Both New Brunswick and PEI developed their central elite seed farms (at Bon Accord and Fox Island respectively) to initiate multiplication of disease tested material during the early 1960's. The system was based on the Scottish experience and involved assistance from Scottish scientists from the Department of Agriculture for Scotland. Isolation from other crops is provided by altitude in New Brunswick and by being situated on an island in PEI. In vitro methods have been introduced within the last five years, originally with material from British Columbia but now each province has its own plant-propagation laboratories.

The primary differences between the two provincial systems are as follows:

- The PEI system is organized to produce potatoes of a high health standard but to maintain the maximum flexibility in marketing. In New Brunswick, the majority of seed growers know that all their crop is going for seed production. The only exception is the production of the variety Russet Burbank. It is reported that growers enter this variety for seed with the intention of using it as a source for their own seed if it passes, but place no emphasis on seed production. It is claimed that this practice accounts for the higher level of certification failures found in New Brunswick than on Prince Edward Island.
- The New Brunswick propagation unit is isolated from the elite farm whereas the PEI one is not.
- In New Brunswick there is greater reliance on the tissue culture system with this route providing 100 per cent of the stock going through the multiplication system. In the PEI system, tissue culture is supplemented by clonal selection, testing and multiplication. Because of this, the PEI system does not require the same amount of protected area for raising mini-tubers, and production is limited to one summer crop which is provided with screenhouse protection.
- The PEI seed farm tends to take the multiplication further than the New Brunswick seed farm. It sells only third generation material whereas the New Brunswick farm sells material from the first to the third year.

- The New Brunswick system is a true flush-through system; even if disease-free, seed must drop a class each calendar year. On the other hand, there is still the opportunity for PEI Foundation class growers to initiate multiplications from their own seed plots. This still occurs on an important scale and proposals to change this have been resisted, although the PEI authorities do not consider the foundation plots a serious threat to the integrity of the system because of the implementation of special measures. For example, the federal certification laboratory provides a comprehensive testing service for the potatoes held in these plots involving some 11,000 clones (summer testing of leaves for PVX, PVA, PVY, and PVS, and spring tuber testing for these diseases and BRR).

Seed Potato Certification

Seed potato certification was first officially organized in eastern Canada in 1915, and by 1927 a certification program had been extended to all Canadian provinces under the supervision of the federal government. For the period from 1915 to 1969 the certification was based exclusively on visual inspection. It was only in 1969 that the weaknesses of this system were rectified as a result of the introduction of an elite seed potato certification program. In particular the program was introduced for more effective control of PLRV, Mosaic viruses, and BRR. The new program comprised eye and stem end indexing of suspected tubers from apparently healthy plants and multiplying these within a certification program. Since 1980 procedures have been adapted to modify this program to incorporate new methods which will improve the disease-free status of the material at the apex of the multiplication procedure. Since 1984, micro-propagation procedures are used in the main seed producing areas.

The certification scheme is enforced through the Seeds Act. This lays down minimum standards and procedures to be enforced by all provinces. The regulations are currently under review and new provisions are under detailed discussion. The scheme incorporates

features which are familiar in other seed potato programs including multiple field and tuber inspections, disease indexing of all pre-basic plant material to ensure complete freedom from disease, provisions for compulsory haulm killing, and mandatory disinfection of machinery, vehicles, and farm premises to control diseases. Post-harvest tuber testing in the form of trials of sample lots in the state of Florida in the US is also provided. These are also undertaken by a number of states in the US and Canadian provinces and have been used by the state of Maine since 1937. An expanded program of trials funded by the federal government began in the early 1980's. Samples of EI, EII, EIII, and F fields are collected, dormancy broken and planted in Florida. Disease readings are available by the end of January for the benefit of the seed growers. As long as certain publicized standards are met an additional tag may be attached to those seed consignments, although it must be emphasized that post-harvest testing is not yet a compulsory component of the certification procedure.

Disease-free, Pre-Elite potato stock (cuttings, tubers, or microtubers) are used to initiate a five-generation multiplication system including Elite I (EI), Elite II (EII), Elite III (EIII), Foundation and Certified Class seed. Elite I and Elite II class seed is produced only on specialized seed farms under strict quarantine conditions. Elite III seed is grown by specialized and qualified, registered-seed producers, and Foundation and Certified Class seed is considered to be for commercial seed production. Tables 6 and 7 outline the system and description of class and the various field, storage, grading, and shipping procedures.

Testing is undertaken by the appropriate provincial authorities but supervised by Agriculture Canada. Application of testing EII, EIII and F fields for PVX and PVS is based on collecting a set number of leaves from each field in a predetermined pattern. These tests are carried out by Agriculture Canada. The tolerances are indicated in Table 8.

Table 6. Certified seed potato production system in Canada

Year	Class (Generation)	Description of class
1	Pre-Elite (PE)	This class must initially come from meristem tissue culture introduced into the field by stem cuttings, tissue culture plantlets or from tubers produced in a closed environment. The material, prior to field planting, must be tested and found to be free of Potato Viruses X, S, A, Y and PLRV, PSTV, BRR and <i>Erwinia spp.</i> Only seed farms or selected growers are allowed to produce Pre-Elite seed. Besides zero tolerance for visible virus and other diseases identified in the Regulations, the material must be tested annually in the field for freedom from PVX and PVS. The testing is carried out by Agriculture Canada.
2	Elite I (EI)	Grown from PE seed and must be planted in tuber units (i.e. the pieces of cut tubers must be planted consecutively). Must have zero tolerance for visible viruses and other diseases identified in the Regulations. Random leaf samples are tested for PVX and PVS. Can only be grown by seed farms or selected growers. The testing is carried out by Agriculture Canada.
3	Elite II (EII)	Grown by PE or EI seed and must have been planted in tuber units. Must have zero tolerance for visible viruses and other diseases identified in the Regulations. Can only be grown by seed farms or selected growers.
4	Elite III (EIII)	Grown from PE, EI or EII seed. Ten per cent must be planted in tuber units. Disease tolerances applied as per Regulations. Can only be grown by seed farms or selected growers.
5	Foundation (F)	Grown from PE, EI, EII and EIII seed. Disease tolerances applied as per Regulations.
6	Certified (C)	Grown from PE, EI, EII, EIII or F seed. Disease tolerances applied as per Regulations. This class can only be utilized for fresh to table stock production.

The certification system has been subject to a very substantial review over recent years and proposals for amending the arrangements have been devised. These have been under discussion with interested parties for some time and are still not officially available. It is understood that the most important features of the new proposals are the compulsory introduction of in vitro methods of obtaining disease-free material, the formal introduction of one year of Pre-Elite seed (although this year is recognized in New Brunswick and PEI, it is not part of current

certification rules), restrictions on the use of cutting of seed for the Pre-Elite grades, obligatory post-harvest testing based on laboratory methods, and longer and more comprehensive training of certification inspectors. One other outcome of the review has been an appreciation of the need to formalize many of the procedures which are adopted for the introduction of disease-free material and of testing.

Table 7. Field, storage, grading, and shipping procedures

a. Field inspections:	Two or three inspections (depending on class) are made on each growing crop.
b. Leaf testing:	Fields tested for PVX and PVS must meet predetermined percentage for a given class: (i) PE -Zero percent (ii) EI -Zero percent (iii) EII -2.4 percent (iv) EIII-5.2 percent (v) F -6.8 per cent
c. Roguing:	Is permitted for all diseases except BRR and PSTV for which there is a zero tolerance.
d. Purity and foreign varieties:	Off type plants or foreign varieties are not permitted in the first five classes. Certified class is permitted a low percentage of foreign varieties on second inspection.
e. Storage:	Tubers from different classes and varieties must be stored separately and clearly identified. Each storage bin or lot is inspected for diseases and defects.
f. Grading and shipping:	Prior to after grading and sealing each seed lot is inspected for diseases and defects.

Seed potato certification was provided free of charge until very recently. The government of Canada has however been introducing the principle of cost recovery for a wide range of government services. Thus, a small charge representing a small proportion of the cost has recently been introduced. The cost of subsidizing certification charges represents a substantial cost for the federal government and has led to a detailed review of the cost of this policy. Although the original target was to attain a higher level of cost recovery, it is likely

that regional development objectives in the key seed potato-growing areas will make this difficult to implement for political reasons.

Table 8. Incidence of diseased or foreign plants permitted

Diseases & varietal mixture	EIII Inspection			F Inspection		C Inspection	
	First %	Second %	Third %	First %	Second %	First %	Second %
PSTV	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BRR	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Blackleg	0.25	0.1	0.1	-	-	-	-
Wilt	0.25	0.1	0.1	-	-	-	-
All virus	0.25	0.1	0.1	0.25	0.1	2.0	1.0
All black leg, wilt & virus	0.5	0.25	0.25	0.5	0.25	3.0	2.0
Varietal mixture	0.1	0.0	0.0	0.1	0.0	1.0	0.1

Phytosanitary and Related Issues

Within the Technical Services Department of the National Seed Potato Bureau resides responsibility for all the phytosanitary aspects of the seed potato program and the necessary laboratory services. Within this division, federal responsibility for the technical parameters of the seed program is determined and the responsibility for ensuring that these parameters are kept to, within the program is assumed. Thus, at the federal level, there is concern that the material which is used in seed potato systems is disease-free, is obtained from the correct channels, and that the right technical procedures are used for testing for diseases.

An important concern at the federal level is the identification of the correct channels through which the industry can obtain its material. Currently there are four approved sources two of which are the regulated laboratories in British Columbia and Quebec where a very strict protocol in laboratory practice is laid down and enforced. It is also possible to obtain material from the post-entry quarantine station run by the Department of Agriculture, through which all material from other countries must pass. In addition to this, though it remains a controversial issue, approval has been given for mini tubers to be imported directly into Canada using the protocol adopted by Plant Genetics, a mini tuber exporter in California. Procedures used by this company have been accepted as not requiring quarantine facilities, but the demand for this material has

been very limited so far and has been restricted to one particular variety required for rapid bulking up in Alberta. A decision to allow this source of disease-free material has caused great consternation in the two principal seed-potato-producing provinces. The principal argument the seed-producing provinces put forward against the use of Plant Genetics material is that the disease-screening and testing procedures are not as rigorous as is required for a seed potato program. Also, they claim there is greater physiological stress in the private laboratory systems through long-term in vitro storage and the use of plant regulators in the in vitro growth medium.

Naturally the implications for the provincial potato-seed sectors could be serious if this new source of disease-free seed was to be accepted. It is understood that procedures used to produce the mini tubers are identical to those being adopted within New Brunswick and PEI to produce mini tubers. The price at which these mini tubers are being sold is reported to be 50 cents per tuber.

An important feature of the Canadian system has been the maintenance of controls over any plant material brought into the country. While historically Canada has had problems with bacterial ring rot and PSTV, it has the advantage of being free from some diseases which have important economic significance in the main, competing, seed industries in Europe. In particular it is free from potato wart disease (*Synchytrium endobioticum*) and from the two potato cyst nematodes (*G. Rostochiensis* and *G. Pallida*). The need to prevent the potato wart disease fungus and later the golden nematode from gaining a foothold in Canada initiated legislation which prohibited the importation of potatoes from anywhere except certain designated areas within the United States. These regulations were consolidated in the 1969 Plant Quarantine Act which also introduced special regulations for the movement of plant material and traffic between Newfoundland and the rest of the Canadian mainland. These measures have undoubtedly made some contribution to the absence of a number of diseases from Canada (e.g. a new strain of PVY (tobacco vein necrosis strain), tobacco rattle virus, potato mop top virus, gangrene, and bacterial wilt (*Pseudomonas solanacearum*).

Recognizing the nature of the problem posed by BRR and PSTV the federal government has supplemented its seed certification legislation with specific disease-eradication acts.

In order to provide backup to certification and disease-eradication efforts in the provinces the federal government also funds laboratories for disease testing in New Brunswick and Charlottetown. It provides testing of material at the central Elite seed farms including, for example, summer virus tests on all tissue cultures and clonal nuclear stock material, and BRR tests on all nuclear stock material. Regular testing of all EI and EII varieties sold off these farms is also undertaken as well as PVX and PVS testing of seed grown on seed farms. It is working to develop reliable procedures to detect pathogens in the tuber and, if successful, will result in the phasing out of the Florida tests. For example, 120 lots from the 1986 crop in PEI will be tested for PVX, PVA, PVY, and PLRV in the laboratory and in Florida to assess the validity of the post-harvest virus test. The laboratory tests would speed up the results and facilitate receiving post-harvest test results before the main off-shore export season. Testing of material to meet export requirements is also undertaken, as is test method development and special measures for disease eradication. In this latter category are included special surveys to assess the status of the most important diseases (BRR and PSTV), and for this purpose special funds are available to support laboratory space and staffing.

Within the seed certification system there is a zero tolerance for BRR and PSTV. The resulting cleaning up of potato stocks has reduced the incidence of BRR and PSTV. In fact no outbreaks of the latter have been observed for a number of years. In addition, the improvement in diagnostic procedures and provincial restrictions on the import of seed potatoes from the United States, and the mandatory use of certified seed in PEI and New Brunswick, may also contribute to further decline of BRR. Wherever any outbreaks occur special measures are implemented to disinfect and isolate the farm concerned.

Provincial legislation reinforces national legislation. Special provincial disease eradication acts have been implemented to cover a wide range of diseases but in the main seed

potato-growing provinces of PEI and New Brunswick, the principal causes of concern have been BRR and PSTV. In these provinces the disease eradication acts have introduced special measures such as the mandatory use of certified seed and strict procedures for dealing with outbreaks, and the future use of the land on which outbreaks occurred.

Quarantine Provision

The federal government post-entry quarantine station began its work in 1985. Prior to that quarantining was undertaken in Fredericton. However, a review of plant health procedures in the early 1980's revealed a risk of disease being introduced, unless proper facilities were developed and greater isolation of quarantine facilities arranged. The establishment of the new station coincided with the substantial upsurge in interest in importing new varieties into Canada that developed in reaction to the possible introduction of plant breeders' rights. Within the eighteen months of operation of the station, some eighty new varieties have been submitted for testing for release to the seed industries in New Brunswick and PEI.

These varieties are principally Dutch, French, British, and Irish, and represent a radical new development in relation to the Canadian seed potato industry. This material is accepted at the discretion of the Canadian Department of Agriculture and it takes roughly one year for the quarantine testing to be completed and the variety to be available within the country. Nearly all of these varieties are privately owned and much of the activity is speculative aiming at the huge rewards obtainable from finding a significant place on the North American market. It is understood that this facility can be available at a nominal charge, although all Canadian public authority activities are under pressure to pursue a policy of cost recovery on their service and the same policy is being considered in relation to the quarantine stations.

Disease-Control Measures in the Provinces

Disease control is largely accounted for by the seed certification system although there are several very important adjuncts to this. In particular there are provincial disease-eradication laws which have implemented a number of critical measures. The PEI plant disease eradication act was introduced in 1974 and New Brunswick followed with similar legislation in 1979.

In both provinces a committee was established with interprofessional representation to promote disease awareness and advise the Minister. The disease eradication laws allow inspectors to inspect wherever they have suspicion that there may be a problem, and establishes procedures for dealing with an outbreak. They also formalize the specific arrangements for dealing with BRR outbreaks and the controls on the future use of the land for potato production. Supplementary certification procedures are also included to enable tighter controls on movement to be imposed if necessary.

In PEI there are specific provisions for disinfection of vehicles used for potato transport (including a compulsory disinfection center to be used by all trucks coming onto the island) and a requirement, introduced in 1987, that all potato producers should plant at least 10% of their areas with foundation class seed to ensure that all farms are subject to inspection. In addition, all potato growers must apply to register their crop, even if they are only producing for processing or table stock. Obtaining a license to grow is dependant on acceptance of measures to safeguard disease contamination. There are also provisions for free burial of cull potatoes and for compensation payments should BRR be identified. These latter are considered vitally important if farmers are to be encouraged to report all outbreaks of disease.

In New Brunswick, the laws also include provisions for the establishment of specially designated seed production areas in which high-grade seed shall be produced if it is requested by 80% of the seed potato producers in the area. Within these areas, growers undertake to adopt special measures for disease control, and there are provisions for the restriction of movement of

potatoes, and for the disinfection of all vehicles visiting seed farms. Two areas in New Brunswick have been designated although in only one of these areas (Glassville) have the producers formally agreed to the establishment of the arrangements. Also, in New Brunswick there is an arrangement for all non-seed crops to be inspected as part of measures to control BRR. This involves checking that certified seed has been used, by collecting seed tags, and field and harvest inspections which are administered by the New Brunswick Seed Potato Growers Association and staffed by casual labor under supervision of experienced crop inspectors. The association is also involved in operating the disinfection service on behalf of the provincial government.

In New Brunswick there are also provisions for mandatory killing of vines, administered by a topkill committee which involves federal and provincial staff and growers. This committee has a majority of officials. Aphid alerts also operate in PEI although there is no compulsory burning.

Potato Breeding

The entire potato breeding effort in Canada is publicly funded and there are no private breeders. The national breeding program is located at the Agriculture Canada Research Station at Fredericton, New Brunswick, and is funded by the Agricultural Canada Research Branch. Other breeding work is undertaken by the University of Guelph in Ontario, Newfoundland, Quebec, and in Alberta. It is understood that this work is funded by a combination of state and provincial funds. The program involves a range of conventional and novel techniques using germplasm from a number of national and international sources.

The national program produces 70,000 seedlings per annum as part of its commercial breeding activities, with selection trials being undertaken on a number of sites in the Maritime Provinces. However, the objectives of the program are fairly broad with a responsibility to meet the requirements of the country as a whole. Collaboration for the evaluation of early material from collaborators across the country is therefore sought. Because of its advantageous

location the national program has a major interest in producing potatoes for the Maritime Provinces.

The breeding objectives are reviewed annually. There is no formal involvement of the industry in the identification of breeding objectives, although informal contacts are encouraged. As so much of national production is for the processing sector this makes communication with the industry fairly straightforward since the ownership of this industry is so concentrated. The breeding of Shepody, an excellent variety for french fries use, is regarded as a good example of cooperation with McCains. The variety was selected as a result of selection which involved joint trials undertaken with the industry.

In addition to processing objectives there is some breeding effort being applied to producing better table stock varieties. This is principally for a russet variety for packaging as count pack in supermarkets. Interest in yellow-flesh varieties is also growing as is interest in novelty skin colors.

Breeding for export has been pursued since the mid 1970's although the amount of effort devoted to this is limited. There is early generation selection of varieties with a higher set and smaller size.

New Variety Development and Promotion

Once a new variety has been identified and licensed there is no organization to promote that variety. In fact, the potato-breeding program has been sufficiently concerned about this to issue its own management profile for the variety it has produced. In addition, there is no formal system for recording varieties in Canada using recommended lists. Thus the rate of development of the area of new potato varieties depends to a large extent on the extension workers operating in each province, and on informal information networks.

The absence of an agency with the brief to promote state-bred varieties could prove to be a handicap when plant-variety rights legislation is introduced. In these circumstances privately owned varieties will be subject to heavy promotion, and they would find relatively little

opposition from competing varieties. For similar reasons, when plant-breeders' rights legislation is in place, there will be a need for objective advice for farmers on the relative merits of potato varieties. This advice would best be based on the evidence of trials which are undertaken by an independent organization. RIVRO and NIAB (see later) in The Netherlands and the UK represent examples of these independent variety testing organizations. No similar organizations exist in Canada, although variety evaluation is undertaken in each province. For example, the Central Elite Seed Farm in PEI is evaluating new varieties, and similar activities involving the Bon Accord Elite Seed Farm and the Seed Potato Growers Association are undertaken in New Brunswick.

The only attempts to obtain variety promotion by the granting of exclusive rights to a variety have involved the varieties Shepody, Donnal, and Brador. In the case of Shepody, McCains has been granted exclusive rights in most European countries under legislation devised for exploiting the inventions of civil servants. McCains was granted exclusive rights to Donnal and Potato Canada to Brador; reportedly to provide the industry with the experience of plant-breeders' rights. Seecan, an organization comprising a number of shippers and merchant growers of cereal and other seeds was established specifically to exploit state-owned varieties in 1976, but its work has excluded the development of potato varieties.

Potato breeding is not undertaken under the responsibility of any of the provincial organizations either public, semi-public or private. As noted above the federal potato breeding program is based in New Brunswick, but it is funded entirely by federal funds and services the Canadian seed potato industry. As there is no plant breeders' rights legislation in Canada there has been little incentive for taking private initiative and none of the public authorities in these two provinces have considered an investment justifiable.

New genetic material is obtained through the federal breeding program and also through introductions of material from other countries. Until very recently this material has primarily consisted of free varieties principally of North American origin. The only variety under private ownership which has been grown in recent years

has been Desiree which was introduced by McCains on license from the Dutch breeders ZPC. This variety is reaching the end of its period of protection under plant breeders' rights in most countries and therefore its cultivation in Canada under licenses presented the little danger of loss of control of the genotype.

For all free varieties registered under the Canadian national list, maintenance is undertaken by the provincial Department of Agriculture in New Brunswick and the PMB in PEI. As noted above there is now considerable interest in introducing new genotypes because of the possibility of plant breeders' rights being introduced in Canada. In fact, plant breeders' rights are not necessarily a precondition for the introduction of a monopoly controlled variety and its commercial development. Under the provisions of international agreements the Canadian government has undertaken not to certify any variety which is under plant breeders' rights in other countries without the permission of the breeder. Thus, a variety could be grown for seed under contract and with the agreement of the breeder or his agent the seed could be certified. However, no royalty payments could be collected and once it was commercialized it would not be eligible for registration for plant breeders' right in Canada should they be introduced. It would be preferable for most breeders if plant breeders' right were available.

The main aim of introducing new varieties would appear to be the United States market. There is a view that some of the introduced varieties could be of interest in this market, although whether they can be adapted to the short growing seasons for economic multiplication in Canada is an unresolved question. Certainly the old Dutch variety Bintje appears to have adapted well and its popularity is growing.

There is general recognition that the seed industry could be radically altered with the introduction of plant breeders' right, although it is acknowledged that the change is quite likely to be gradual. Plant breeders' right are seen to provide more incentive for variety development and to resolve some of the difficulties in developing seed potatoes in export markets.

Release of Material Into the Multiplication System

In a private potato breeding system where the varieties are monopoly-owned the process of identifying the variety to be multiplied and the quantities involved is resolved in a very straightforward manner. The breeder or his agent, who will be a seed potato merchant, will decide, on the basis of his feel of the market, how much material will be required of each variety at different certification levels. He will initiate the striking of material from a disease-free source and will allocate this material from growers on contract. It is normal for the breeder to work with the same group of growers to ensure maintenance of standards and discipline. The decision on how much material should be multiplied is a commercial one, and the risk is borne by the private breeder or his agent. Because the risk involved is substantial, rather elaborate systems for sharing the risk among the different parties concerned are devised.

Where publicly owned varieties are concerned and there is an agent acting on behalf of the State, a very similar procedure can be adopted although one characteristic of this situation is that the agent for the state breeders is subject to a wider range of pressures simply because the variety he is handling is State-owned and not privately owned. The extent to which there is a different approach here depends on whether or not the State breeders, or those who administer their programs, consider they have commercial objectives (with the aim of maximizing their return from their investment in producing the new variety) or whether they consider that they have wider objectives which might include assisting the development of the seed potato or table potato industries.

Where free varieties are considered, the situation is more complex. In this situation the varieties are likely to be maintained by a public or semi-public body such as the New Brunswick Department of Agriculture or the PMB in PEI. The decision on how much material to release into the multiplication chain can be coped with in a number of different ways. The most straightforward way is to allow high-grade seed potato growers to request their requirements. The major difficulty with this allocation

procedure is that it is possible that individual high-grade seed growers may together request more material than might be justified by market requirements in future years. In order to overcome this danger it may be necessary to introduce some kind of rationing system to control the amount of material released. In this case, the arrangements for deciding how the allocation should be made and what form of rationing should be introduced is vitally important. There are substantial risks involved because it is very uncertain what demand there will be for different varieties in future years. Thus a restriction in supply which is too enthusiastic will lead to very high prices in the future and complaints from seed growers who are not able to get enough seed and from table potato growers who are having to pay very high prices.

An important issue here is the selection of high grade growers. These growers have the highest status in the seed multiplication chain and because of their importance to the entire chain their situation is favoured by the various regulating authorities. Such is their status that membership of the "club" of Elite growers is often sought after. Acceptance of new members will depend on an assessment of the ability of the grower to meet the approved standards, given his farm circumstances and his proven skills and experience. As a result the invitation to become an Elite seed grower will follow either formal or informal recommendation.

New Brunswick

In New Brunswick the committee involved in deciding the amount of seed to be allocated is a sub-committee of the Elite seed farm (Bon Accord) management committee. This comprises representatives of the New Brunswick Department of Agriculture, Agriculture Canada and the manager of the seed farm. The small group of Elite growers submit requests for the material they require and there was relatively little evidence of any rationing. Material can be made available as greenhouse tubers, Pre-Elite, EI, or EII material. Seed is released from the Elite farm on the basis of the growers performance in utilizing seed in previous years and the availability of seed.

The recent development of a reliable and well equipped plant propagation laboratory and the possibility of monopoly-owned varieties being available for controlled multiplication has promoted a revision of the release procedure. There are now provisions for greenhouse tubers and potato plantlets to be made available although they will need to receive a recommendation from the Food Production and Inspection branch of Agriculture Canada. In putting forward an application for material the grower must provide a marketing plan for any new varieties and for exclusive releases or private varieties. For varieties which have been sold commercially for over five years the committee will make an allocation if the grower can give evidence of a new and expanded end-use which must be satisfied within a two-to-three year time frame from the time the material is received.

The current New Brunswick allocation system which allows for these new developments is illustrated in Table 9.

Table 9. Scheme for allocation of basic seed potatoes in New Brunswick

Source	Class of material	Allocation to	Certification
Plant propagation center	Pre-Elite plantlets	Elite and recommended growers as requested and if possible	Field grown PEI-EI-EII-EIII Greenhouse grown: PEI-PEII
Bon Accord Seed Farm	Greenhouse tuber	Elite growers as requested and if tubers available	Whole - PEI Cut - PEII
Bon Accord Seed Farm	Seed EI	Elite growers if seed available and on request	
Bon Accord Seed Farm	Seed EII	Elite growers if seed available and on request Recommended growers if seed available and on request	

The principal problem with the release procedure in recent years appears to have been caused by the very rapid expansion in the demand for the variety Shepody as a result of processing demand. While processing interest in the variety has been acknowledged, and close liaison exists with the processing industry in New Brunswick, the rapid up-take by the processors had not been predicted. It is easy to see how this could have occurred if we keep in mind that the processors were assessing this variety on a

season-by-season basis and they increased their contract commitments with Shepody on the basis of cumulative experience. In New Brunswick the material is made available to Elite growers at a nominal cost. The central Bon Accord Elite seed farm in New Brunswick is seen as a service to the New Brunswick seed potato industry and cost recovery by the sale of seed potatoes is not a major objective.

A problem which has arisen is that Elite growers do not always sell to the recommended growers and may sell EIII to Quebec or Maine. This has meant that not all the advantages of developing the seed system within New Brunswick has accrued to New Brunswick seed industry.

Prince Edward Island

In PEI, the Central Elite Seed Farm at Fox Island is managed by a special committee which is concerned with all aspects of the PEI seed potato industry. It is this committee which decides how much material should be produced and the contract conditions, (including the formula for calculating the price at which it should be sold).

Seed sales represent an important source of income for the PMB. However, the seed-farm expenses substantially outweigh the income achieved from the sale of Elite potatoes to seed growers. Even so, the fact that the PMB is responsible for many of the functions of the PEI potato industry and has to ensure that those responsibilities are adequately financed, means it has developed a rather more sophisticated method for raising money for the sale of material from the seed farm. The Board has introduced a contract which covers the sale of Elite seed and regulates the circumstances under which those seed potatoes are used. The PMB is also considering the introduction of contracts governing the sale of seed potatoes from Elite growers to other potato growers on the Island. Their concern derives from recognition that because of the allocation policy, Elite seed growers are in a monopoly position when selling the multiplied seed. They feel that this monopoly can be exploited and that there should be some means of regulating the prices which can be achieved.

Regulation is very much part of the potato system in PEI and there are other facets of the way in which potatoes are bought and sold which has involved the Board in distorting normal forces. For example, only a certain proportion of seed can be sold before a specified date in the autumn. This measure has been introduced to protect those potato growers who might be less well placed to put in their orders early in the year for one reason or another.

Market Support and Regulation

Market Support at the Federal Level

Potatoes are not included in the list of commodities which are subject to obligatory stabilization payments by the federal government. For certain commodities a stabilization payment is made if the price in any year is lower than a pre-defined level. However, the potato sector has received payments on an ad hoc basis. For example, in 1985/86, payments were made to PEI and New Brunswick potato producers to assist the diversion of potatoes into "fertilizer, livestock feed, and potato granules for later resale" because the market situation was so serious. Over the last decade some \$57 million has been made in the form of market support payments. A national scheme which includes quotas is currently under consideration.

Market Support at the Provincial Level

Clearly given the geographical situation of New Brunswick it would be very difficult for it to undertake any market regulation in the form of maintenance of minimum prices, quotas, or measures with similar effect. Also it would be very difficult for New Brunswick to undertake such activities in isolation, as restrictions of supply from the New Brunswick area or minimum prices would easily be exploited by potato suppliers from other provinces and, in particular, from PEI.

As the result of continuing pressure on the prices of potatoes the New Brunswick producers have been instrumental in asking for a federal scheme for the regulation of the potato market

referred to above. Within the New Brunswick industry there has been substantial concentration of production into fewer hands over the years. The main production area in the north of the St. John valley produces most of the seed potato output. Producers in the main production areas of New Brunswick are highly dependant on the potato crop for their income and when prices are low they suffer considerably. Finding a solution to this problem poses enormous difficulties. Any attempt to raise prices in Canada on a federal basis can only result in reduced competitiveness in the United States market which is very important to provinces such as New Brunswick. Also, with a high gearing to supplying potatoes to the processing industry, there could be adverse effects as a result of the reduction in competitiveness of these processing industries in comparison with their competitors in the United States.

Because of its island status, PEI has more alternatives for improving the market power of the potato sector. The principal method is the maintenance of minimum prices for the sale of potatoes off the island during certain periods. This can be used to prevent PEI dealers undercutting each other, although clearly there are limits to how this can be used because of the availability of potatoes from other sources. PEI potatoes are very distinctive as they are grown on red soils. This characteristic has been associated with better quality and, as a result, the PEI sector is able to gain a premium and hold prices up at certain periods. While some exporters and dealers might find the imposition of this control very restrictive, there is a lot of support for the continuation of these measures.

Promotion

The PMB of PEI and the NBPA have assumed responsibility for the promotion of the potatoes from the two provinces, and their activities are funded by levy on the industry. This applies in both the United States and in the domestic market. In both provinces there is assistance from the provincial governments where officials have responsibility for market development and promotion.

In the case of off-shore export markets, Potatoes Canada has responsibility for the promotion of Canadian seed potatoes. It is funded by the federal and provincial governments and the PMB and NBPA. Also there is a levy on all exporters. Disputes over the method of funding Potatoes Canada has left it very short of resources and at the time of writing this report its activities were at a low level. A large part of the difficulty comes from the problems of funding an organization from two main, potato-producing sectors each with a very different export emphasis. The rivalry between the two provinces has made it difficult to find a harmonious way of resolving the funding difficulties.

Other Support Activities

Credit

The federal government operates an advance-payments scheme for seed potato growers. This provides farmers with credit facilities to assist paying for the inputs of the next crop. The agents for the scheme are the NBPA and the PMB.

Crop Insurance

In addition, there is a federal crop insurance scheme which is operated in each province. The agents for the scheme are the respective provincial governments and these schemes will also provide sponsorship to meet the needs of the local agriculture. The insurance will cover yield losses only against designated perils and farmers with a minimum of 3 acres (1.2 ha) are eligible. The crop is covered for 75% of the established average yield of a farmer and this can be converted to a value by choosing a price. The premiums vary according to the price option chosen. In the principal potato production areas crop insurance is popular.

Other General Assistance

In addition at federal level there are a wide range of support services carried out by other departments. There is close liaison between that

section of the Department of Agriculture concerned with foreign trade since many of the issues concerned with exporting of Canadian seed potatoes are intimately connected with plant health issues. A major difficulty over the last decade has been the restrictions which have been imposed on Canadian seed potatoes when they are exported to the European Community. Canadian potatoes are now subject to quotas and restrictions which have seriously restricted the importance of the European market. As Portugal and Spain were important markets, the enlargement of the Community has thrown up new problems for Canadian seed exports. The major bone of contention has been the incidence of bacterial ring rot in Canada. Because of the implications for trade this particular disease has attained a very high political significance, and incidence of the disease and control measures to be taken are very sensitive issues for discussion. The Canadians acknowledge that bacterial ring rot has been a problem although they point to specific eradication methods which have considerably reduced its incidence. In the light of bacterial ring rot outbreaks in the EC (confirmed in recent years in Denmark and Lower Saxony in West Germany), there is some bitterness about the continuation of trade restrictions with the EEC.

8. Background to the Dutch Potato Industry

Production, Area and Yields

Annual average Dutch potato production over the period 1980 to 1984 inclusive has averaged 6.5 million tons. However, in each of the years 1984 to 1986 the figure exceeded 7 million tons (Appendix 1, Table 1). Potatoes grown for starch production comprise roughly one third of this total. Over the last decade there has been an increase in the table and seed potato output and a decrease in starch output. The five-year, average output for each consecutive five-year period starting 1955/9 was 6.5, 5.9, 5.9, 4.3, 3.8 and, 3.3 million tons. At current production levels the Dutch potato industry is the joint third largest producer of potatoes in the European Community and the ninth largest producer in the world.

The bulk of table and processing potatoes are produced in the provinces of Zeeland, North Brabant, and South Holland to the south west of the country. Starch potatoes are confined to the north and east, and seed potatoes to the north, center and west.

In total, there are some 15,000 businesses growing at least 0.5 ha of table and seed potatoes with an average area per business of 7.1 ha. Three quarters of the total table and seed potato area is grown on the clay soils in the west of the country. On these soils, the average potato area of the farm tends to be larger. There are some 4,750 businesses growing starch potatoes with an average area of 12.7 ha per farm. The starch-potato industry is regarded as a completely separate sector, with transfer of potatoes between this and the other potato sectors being most unusual. All starch potatoes are grown on contract to the single, cooperatively owned starch-potato company.

For both table potatoes and seed potatoes the area grown in each year of the 1980's has been higher than the average during the last 5 years of the 1970's (Appendix 1, Table 2). This has been explained by a gross margin for potato production that is consistently attractive

compared with that of alternative crops in the main production areas.

The average gross yield per hectare has been in excess of 40 t/ha for the three harvest years 1984 to 1986 (Appendix 1, Table 3). During the 1970's, no real growth in yields was evident. Potato yields are now approaching 50 t/ha and the average yield for seed potatoes is between 30 and 35 t/ha. The latter yields have increased substantially in 1985 and 1986 because of much lower aphid incidence and the consequent longer growing period before haulm killing. The improvement in yields of table potatoes has come to a large extent from improved husbandry of the crop. The genotype range for table potatoes has remained fairly stable with the variety Bintje accounting for the vast bulk of the output. Yields tend to be highest in the new lands in the South and East Flevoland Polder. These now average 60 t/ha with much higher yields on some of the newest land. Yields on the rest of the clay soils currently average between 45 and 50 t/ha with yields on the sandy soils to the east ranging from 40 to 44 t/ha.

The fastest growing areas of potato production are those of Zeeland and the South and East Flevoland Polders. In seed production the biggest growth has come in the specialized seed areas to the north and west of the country in Groningen and Friesland.

Varieties

In 1986 Bintje accounted for 40% of the total area planted. It is the most important variety grown for table and processing use and also figures very substantially in seed production. The flexibility and use of this variety is the basis of the Dutch table and processing potato industry with the field crop being graded in high capacity grading plants for sale to different parts of the market. The large potatoes are sold for french fries manufacture, the medium sized to

potato chip and table markets, and the small potatoes are used for peeling or speciality markets. Other potatoes grown for the table and processing markets are Eigenheimer (primarily for consumption in the south), Irene (primarily for consumption in the north), and Saturna (primarily for potato chips). Varieties grown for the starch industry have a very high dry matter content and are not suitable for table or processing use.

A very wide range of varieties are grown for seed production, many of which are destined for export markets. The varietal range therefore represents the requirements of these export markets (Appendix 1, Table 11). The turnover of varieties in the starch industry tends to be very rapid as the intensive nature of starch potato production is accompanied by a very serious nematode problem. New varieties are constantly required to cope with new nematode biotypes.

Bintje accounts for 22% of the total certified seed potato area and the next most important varieties are Spunta (9%), Desiree (7%), Jaerla (5%), and Ostara (3%) (Appendix 1, Table 14).

The Importance of Potato Production

In 1986, potatoes accounted for 22.5% of the total arable crop area in The Netherlands and has been at about this level since the early 1970's. In value terms this represents between 35 and 40% of the total value of arable production but represents only approximately 4% of the total value of agricultural products.

Consumption

Dutch potato consumption stood at 84 kg per head of the population in 1986, representing the fifth highest level of consumption per head in the European Community. One quarter of the consumption is in the form of processed products when measured in raw potato equivalents. Consumption is stable with a slight reduction in fresh consumption being counterbalanced by an increased use of processed products.

Utilization

On the basis of estimates by the Produktschap voor Aardappelen,¹ roughly 60% of total available potato supplies is utilized in The Netherlands with between 30 and 35% exported. On average, of total available supplies 30% is utilized in the domestic starch industry, 14% for domestic, fresh table consumption, 15% for domestic processing, 6% for domestic seed requirements, 20% exports for table, processing, or industrial utilization, 7% seed exports, and 8% feed use or waste.

Trade

The Netherlands is the most important potato exporting country in the world. It has an important export trade in table, seed, and processed potatoes. For table potatoes the most important market is West Germany which normally takes between 50 and 60% of total exports. This is followed by Italy, Belgium/Luxembourg, France, and United Kingdom. Small quantities are exported to almost all European countries and to many other countries in various parts of the world. In recent years, Algeria has represented an important table-potato market taking from 5 to 10% of total production exports. The three-year, moving average of Dutch table and processing potato exports has increased consistently from the early 1960's, and for the three years 1983/5 stood at 1.3 million tons on average. In recent years 50 and 60% of seed production is exported with roughly half destined to markets outside of the EC.

The Netherlands imports relatively small quantities of potatoes, normally during the early part of the season when production from Mediterranean countries competes with stored Dutch potatoes.

¹ Translations and brief descriptions of functions of this and other Dutch organizations are given in Appendix 4.

Prices

Potato prices vary considerably from year to year. In recent years the development of french fries capacity in The Netherlands and surrounding countries has induced a premium for larger sized potatoes. Price quotations are most commonly given in the two-size bands 35 to 50 mm and 50 mm upwards. In some years the price of the larger-sized potatoes can be twice that of the smaller standard. The overall price situation is affected by the availability of supplies in all other European countries. However, as many of these countries are subject to similar climatic influences there is relatively little opportunity for balancing surpluses or deficits between countries. Because of the dependence on exporting the performance of the Dutch potato industry is highly dependent on market conditions in these other countries.

A futures market operates in Amsterdam and provides the opportunity for hedging to reduce the risks of price volatility. It is reported that producer hedging use is small. This is just one mechanism adopted in the Dutch system to cope with price uncertainty. A wide range of contractual arrangements are used by the industry to share and spread the risks of potato growing.

The Processing Sector

The quantity of potatoes processed in the Netherlands has consistently increased since the mid 1960's. The bulk of the growth has come in the area of pre-fried products and particularly for frozen french fries. Production of dried products varies from year to year and has increased very slightly in recent years. The production of snack products such as potato chips has been stable. In 1986, 1.4 million tons per annum were utilized as frozen french fries. Just over 60% of potato processing output is produced by four factories, each with annual throughput of more than 100,000 tons of potatoes. The french fries sector is dependent upon the variety Bintje and this variety is also used for potato chips and dehydration although the variety Saturna is being used increasingly for the production of potato chips.

The volume export of processed potato products is increasing every year with the bulk of the growth coming from the french fries industry. The largest market is West Germany which in 1985 took 41% of total Dutch processed product exports. Other important markets are the United Kingdom, France, Belgium, Italy, and Ireland. Only 3% of total processed product exports goes outside the European Communities.

Market Infrastructure

The bulk of table potatoes are sold through primary wholesalers of which there are roughly 100 who sell at least 1,500 tons per year. Large cooperative organizations feature prominently as wholesalers, although there are some large, private companies as well. A large part of the wholesale trade involves exporting, and many of the wholesalers participate in exporting. The crop is graded in central packhouses into 35 to 50 mm and 50 mm upwards sized categories, although other appropriate size grades are made available. A variety of different procurement methods are used by the wholesale trade with a sizable proportion of potatoes being purchased at free open market prices. Contract sales have developed in a wide variety of different forms. This includes "pool" contracts where a farmer will commit his potatoes to a cooperative or private company. He then receives the average price achieved by that wholesaler in selling all the potatoes committed to the variety pools he participates in. There are also fixed price and participation contracts as well as the selling of the crop in the ground. In addition, some wholesalers grow their own crops on land which they own or rent, although this is still a relatively unimportant feature of the system.

In the seed sector a similar pattern exists with a number of very large wholesalers dominating the sector. While some of these companies also trade in table potatoes, a number have specialized as seed merchants. The bulk of seed potato production is undertaken on contract for one of the major seed companies. This development of a contractual system has been encouraged by the availability of plant breeders' rights and the important presence in the Dutch market of monopoly-owned varieties, principally

for the export market. There is also open market selling of some of the free varieties, particularly Bintje for use in The Netherlands and other neighboring countries. As indicated earlier, the starch industry is completely separate from the other potato sectors. The single cooperative starch manufacturer purchases all his potatoes on contract from grower members.

Because of the importance of size grading within the Dutch system all processors purchase their supplies from the wholesale trade. There is a certain amount of vertical integration with some of the major wholesalers also being involved in processing.

Market Regulation

Within the Dutch table and processing potato sector there is no formal market regulation except the imposition of minimum quality standards. All producers and wholesalers are licensed, and levies are obtained from them and processors to support a central body. This body (the Produktschap) has a number of broad functions including the provision of statistical and market information services, funding an agency to promote Dutch potatoes (NIVAA), and representing the industry as a whole. However, it does not intervene in the market. The Dutch table-potato sector has developed a wide range of mechanisms to cope with price instability. As indicated above, a wide range of contractual arrangements have developed, and these can be combined with free market sales to adjust the risk profile required. Similarly the whole credit system is geared to instability with the principal farm credit institution, the RABObank, being fully aware of the vagaries of the market but recognizing the fundamental security of the Dutch potato sector. Also a futures market offers hedging facilities.

The seed potato industry is organized separately although, again market regulation is limited and restricted to a self-financed intervention agency which acts as a buyer of last resort for potato varieties in over-supply. Levies are also collected from seed producers and seed wholesalers to fund the Pootaardappel Contact Commissie (PCC). This organization has two major functions. The first involves the

administration of the Stopa Fund and the second the channeling of funds to the potato promotional agency NIVAP (see later). Both the Dutch table and seed production industries are advocates of liberal trading conditions, a stance they have taken in view of their ability to sell competitively in world potato markets.

9. The Dutch Seed Potato System

General

The output from the certified seed crop is sold exclusively for seed use except for a small quantity which does not find a market as seed either because of very low prices or of defective seed quality. In some years larger sized or surplus seed tubers may be sold as table potatoes on the home or export market. However, in general, the seed potato industry can be considered separately from the other potato sectors.

Depending on yields, the total output of certified seed potatoes less storage losses is between 0.7 and 1 million tons. This quantity has increased consistently since the mid 1960's. In recent years, the total seed output has been disposed of in the following way:

Table 10. Disposal of the Dutch seed potato crop

	%
Retained for farmers' own seed use	5 - 7
Sold as certified seed in The Netherlands	20 - 25
Exported	50 - 60
Residual (human consumption, animal feed, intervention (STOPA))	10 - 20

In most of the main seed-producing areas all producers must use certified seed. In some areas once-grown seed is permitted. Appendix 2 reconciles total seed requirement with total certified seed availability for use in the Netherlands. On the basis of the data from the Produktschap and NAK we estimate that 94% of seed used is certified.

There is relatively little government regulation, and activities for the common good of the sector are largely administered and funded by the interprofessional organizations. There is however an element of government supervision in certain key areas (e.g. seed-certification standards and plant-health matters). As a result

of the interprofessional involvement in the organization of the sector, the critical interface between the core seed potato production activities and the various essential support services are relatively well dovetailed. There is a flow of information from the market place back to important elements of the potato marketing system to ensure that they develop in such a way as to give Dutch seed potatoes the best opportunity for being sold in the market place. Because the Dutch industry is so very dependent on export markets, it has commercial considerations which have been paramount in determining the nature of the various institutional initiatives which have been taken to provide certain essential support functions.

A key feature of the system is the presence of plant breeders' rights legislation and the strength of the private breeding sector. This feature has reinforced the liberal nature of the sector and its market-orientated nature. The private breeders, acting either independently, or, more usually, through agents, initiate their breeding program on the basis of their perceived needs of the market. Similarly, the multiplication of their protected varieties is undertaken on contract according to the requirements of the market.

Seed production is concentrated in the northern central (polder area) and western half of the country on a range of fertile sea clay soils. A wide range of whole-seed, size grades are produced to meet home and market requirements. These are certified into six separate grades according to generation, and to whether or not the parent seed was bought-in or own grown. The system will be explained in the Section of Seed Potato Certification in this Chapter. Seed potatoes in The Netherlands are grown from whole seed, and cutting, although permitted, is rarely practiced. Similarly, potatoes grown for other purposes are also largely grown from whole seed. Seed potatoes are planted in April and harvest varies, depending on variety and levels of aphid infestation. Harvest is normally between the beginning of the third week of July

and the end of the second week of August. In recent years, the harvest date has been towards the end of this range because of very low aphid populations.

Under the Dutch system, seed potato production is based on clonal selection. Micro-propagation is used to produce one quarter of the disease-free material at the top of the multiplication pyramid. The principal disease and pest problems are the fungal diseases late blight (*Phytophthora infestans*) and rhizoctonia (*Rhizoctonia solani*), the bacterial disease blackleg (*Erwinia carotovora*), virus diseases and potato cyst nematode. In recent years virus diseases have become less prevalent as a result of efforts to clean up infected clones and lower levels of aphid populations.

The Netherlands has not defined protected basic seed areas under the EC Directives on seed potatoes. To have done so would have meant restricting the movement of potatoes into these areas. This would limit traditional movements of both seed and ware potatoes. However, certain restrictions are imposed in the main seed potato production areas. For example, only certified seed may be used in these areas for table and processing production and for garden production. Other restrictions include the prohibition of peach trees in gardens to reduce the build up of virus vectors.

Seed Trade

The Dutch seed potato system is very highly orientated towards supplying the requirements of overseas markets. As noted earlier between 50 and 60% of all production of seed potatoes goes for export to a very wide range of markets. Exports have increased consistently over the last 15 years although the rate of growth appears to have slowed in recent years. Annual volumes exported are currently in the region of 500,000 to 550,000 tons. Currently just under 50% of seed potato exports are destined for markets in the European Community of which the most important are France, Italy, Belgium, Luxembourg, and Germany. Roughly 10% go to non-EEC European countries, 5% to North and South America, 20% to Africa, and 10% to Asia (Appendix 1, Table 9). The most significant

increases can be seen in sales to Africa where sales to Algeria and Egypt figure prominently.

Organization

A short description of all the organizations concerned with the Dutch seed sector is given in Appendix 4. The institutional structure of the Dutch potato seed sector is relatively simple. The participants in the core activities of breeding, seed multiplication, and potato seed selling are organized in representative associations. Some of these organizations are constituted under legislation as *Bedrijfschap* which enables them to collect compulsorily levies from their members. Thus the farmers' unions are members of the *Landbouwschap* and the various seed potato trade organizations are members of a seed potato *Bedrijfschap*. The money of the levies collected is then used to fund a central organization, PCC, whose major role is to finance promotion and market support. These two functions are undertaken by an agency, NIVAP, and a foundation, STOPA. These will be described later in this section.

The legislative framework for this aspect of the Dutch organization originates from legislation passed in 1948. The Industrial Organization Act of that year was introduced in the crisis of the post-war years as a means of reorganizing many industrial sectors of the Dutch economy. The legislative framework incorporated the tenets of decentralization of decision making, industrial democracy, and cooperation. It gave, to those industrial sectors which requested them, powers to be responsible for the providing of activities for the common good of the sector and it formally brought together disparate religious groupings of workers and employers. The law enabled organizations called *Bedrijfschap* and *Produktschap* to be constituted. The *Bedrijfschap* were established to serve individual professions (e.g. producers, merchants or retailers separately) whereas the *Produktschap* were interprofessional and covered whole industries. The *Produktschap* therefore serve as the central bodies covering each of the agricultural sectors of Dutch agriculture.

Before a *Produktschap* or *Bedrijfschap* is established a public inquiry is undertaken to establish the support for the organization by a

Social and Economic Board established under the same legislation. In fact, the *Produktschap* were only established to cover the agricultural sector. They remain important today in this sector and represent effective and relevant central bodies for most sections of Dutch agriculture.

The legislation provides the necessary authority for the sectors to undertake a number of activities for the common good. Both *Produktschap* and *Bedrijfschap* have substantial powers to collect levies and to impose sanctions on those who do not adhere to the necessary disciplines imposed. It means that the Dutch agricultural sector is used to being subjected to discipline because the entire post-war agricultural history has involved very tight control of production and marketing practices by the industry bodies.

It is important to note that these powers were granted in a period of extreme crisis in Dutch society and it is difficult to envisage that they could have been established in circumstances other than this, given the liberal tradition of Dutch society.

Another very important factor contributing to the success of the concept is that The Netherlands is a comparatively small country where there is a substantial community of effort which is reinforced because most agricultural products are sold into export markets. In this respect it was fairly easy to recognize that an industry acting in concert will perform better than one which is fragmented. Thus the rules of the *Produktschap* were made by the industry itself, and it is relatively easy for the members of an industry to identify with the need to impose discipline to ensure that the industry has the best chance of competing in overseas markets. At the end of the Second World War, the main emphasis in Dutch society was on providing food domestically but the success of Dutch agriculture led to a steadily developing export market, and the *Produktschap* has proved remarkable flexible in adjusting to this new orientation of the Dutch agricultural industry.

Interprofessional responsibility is a key feature of many of the organizations involved in the Dutch seed potato sector. In particular it applies to the foundation (Stichting Nederlandse Algemene Keuringsdienst (NAK)) which is responsible for administering the seed-certification

service under the supervision of the Ministry of Agriculture. Representatives of the potato industry and breeders also have a very strong influence over the nature of research and applied breeding work undertaken in the State-funded institutes.

Table 11 illustrates the broad responsibilities of the different organizations involved in the Dutch seed potato industry.

Seed Potato Certification

The certification agency, NAK, was established in 1932. The primary function of NAK has been the implementation of a seed-certification scheme within The Netherlands although during its history it has taken a number of other initiatives to develop the seed potato industry. In its early days it provided incentives in the form of prizes to breeders who got their varieties into the officially recommended variety list (*Rassenlijst*). These motivation premiums provided an important incentive for the development of potato breeding in The Netherlands until a formal method for paying breeders for the success of their varieties was instituted in 1938 by the establishment of a breeders' fund, based on a levy placed on the use of all certified seed. However, NAK continued to pay premiums to breeders who got new varieties into the official testing system until 1967 when the Dutch plant breeders' rights legislation was passed.

The NAK is established as a foundation under Dutch law. It is an independent organization, although it is supervised by the Ministry of Agriculture which provides one half of its funds. The management board of the foundation includes equal representation of three members each for breeders, wholesalers, producers, and users of seeds, as well as two scientific consultants. Its chairman is independent (the current chairman is also the head of the national plant protection service (PD)). There is an Executive Board comprising six members. Before the NAK came into existence, the inspection of seed potatoes was carried out by a number of regional agricultural societies as well as some of the trading companies. The initiative in 1932 to establish NAK was principally to stimulate

Seed Potato Systems in Developed Countries: Canada, The Netherlands and Great Britain

Table 11. The responsibility for different activities and functions in the Dutch seed potato system

Sectors	Agency
<u>Main production activities</u>	
+ breeding	IVP, ITAL (both fundamental), SVP (some fundamental but mainly applied) and private breeders (applied)
+ variety maintenance	growers and private breeders
+ generation of initial disease-free material	Elite growers through clonal selection with 1st and 2nd year clones disease tested by NAK. Also some (25%) micro propagation
+ initial multiplication	200-300 Elite growers
+ multiplication	seed growers
<u>Support activities</u>	
+ research	DLO
+ extension	Consulentschap
+ credit facilities	nsp
+ breeding	IVP, SVP, ITAL and private breeders
+ market support	STOPA
+ crop insurance	nsp
+ seed certification	NAK
+ disease eradication programs	PD/NAK
+ plant health measures	PD
+ aphid alert scheme	NAK
+ disinfection service	PD
+ market information	NIVAP/breeders agents/ merchants
+ market development/promotion	NIVAP
+ variety evaluation	RIVRO
+ capital funding for main central production services	nsp
<u>Market organization</u>	
+ producer licensing	Bedrijfschap
+ dealer licensing	Bedrijfschap
+ processor negotiation	nsp
+ transport negotiation	nsp
+ terms of sale contract	nsp
+ sales restrictions	nsp
+ quality control	NAK
<u>Policy</u>	
+ source of disease-free material	NAK
+ lab./plant health procedures	PD/NAK
+ allocation policy	nsp
+ importation policy	PD
+ disease eradication	PD/NAK
nsp	Not specifically provided
PD	Plantenziektenkundige Dienst. Plant Protection Service of the Ministry of Agriculture and Fisheries
NAK	Nederlandse Algemene Keuringsdienst voor Zaaizaad en Pootgoed van Landbouwgewassen. Inspection Service for Seeds and Seed Potatoes
RIVRO	Rijksinstituut voor het Rassenonderzoek van Cultuurgewassen. Government Institute for Research on Varieties of Cultivated Plants
STOPA	Stichting Overleg Pootaardappelaangelegenheden. Seed Potato Intervention Agency
NIVAP	Nederlands Instituut voor Afzetbevordering van Pootaardappelen. Organization for the Promotion of Dutch Potatoes and Potato Products - Seed Potatoes
IVP	Vakgroep Plantenveredeling. Department of Plant Breeding, Agricultural University
SVP	Stichting voor Plantenveredeling. Foundation for Agricultural Plant Breeding
DLO	Directie Landbouwkundig Onderzoek. Directorate for Agricultural Research, Ministry of Agriculture and Fisheries
ITAL	Research Institute ITAL

standardization of approach throughout the whole of The Netherlands. A law was passed which enabled only one organization, the NAK, to undertake seed certification.

In addition to potatoes, the NAK covers fodder crops and cereals. While inspection standards for the country as a whole are established at the NAK headquarters, inspection is organized on a regional basis with four separate regional inspection services established to cover different parts of the country. Each of the regional inspection services has autonomy in relation to certain management issues and has its own Board of Management comprising locally-nominated representatives. The two largest regional inspection services are those of Friesland/Groningen and the North Sea Polder regions with 13,300 and 13,600 ha respectively in 1986, representing 38 and 39% of total Dutch certified seed potato area.

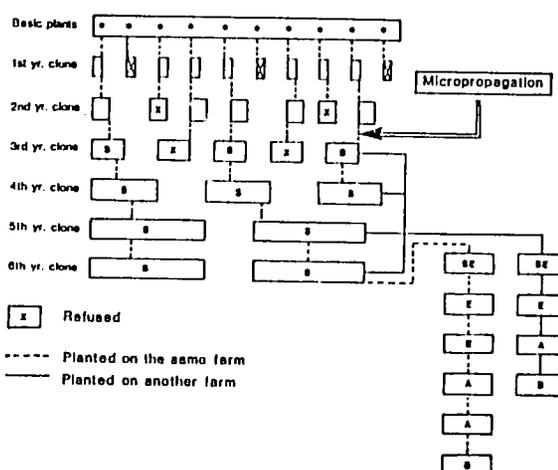
The regulations for certification are established by the board of the NAK but they must be confirmed by the Ministry of Agriculture as the supervisor of the certification standards of the industry. Proposals for amending the regulations are considered each year, and any person within the seed industry can put forward those proposals for consideration by the Permanent Committee for Seed Potatoes. This committee has six members and reports to the Executive Board of the NAK.

For all countries within the EEC, the provisions of Directives on plant health and the marketing of seed potatoes first introduced in 1966 have to be implemented. These provisions legislated in the form of Directives must be incorporated in member states through national laws. The EEC Directives therefore provide a broad framework in which national requirements can be specified. They were originally based on the standards laid down by the United Nations Economic Commission for Europe, which still holds a brief for standardizing quality grades to encourage trade.

A clonal selection system was introduced for the first time in 1948 in order to improve the health status of seed potatoes and particularly to control virus. The seed certification system recognizes six separate classes S, SE, E, A, B, and C. Under the terms of the EEC, legislation on seed certification Classes S, SE, and E are considered to be basic seed, with the later

multiplications considered as certified seed. The classification scheme is shown in Figure 2. The classification depends on the origin of the material used and its class, the result of the field inspection, the haulm killing and lifting date and, for higher grades, the result of postharvest controls.

Figure 2. Clonal selection and classification of seed potatoes in The Netherlands



The clonal selection begins with a potato farmer identifying 'basic plants' which will be used to produce first- and second-year clones. For free varieties these 'basic plants' are identified from the seed growers' own plots of the varieties. In the case of monopoly-owned varieties, special provisions are made for maintaining the variety. At all times this will be under the control of the breeder or his agent and he will identify the basic plants for clonal selection.

Leaves from every first-year clone are tested by the NAK, 50 leaves are tested of each second-year clone and 100 leaves of later year clones. Clones can be entered for highest class of the classification after the second year (i.e. as a third-year clone). The tests cover virus X, S, A, and Y and bacterial diseases. These clones are also subject to inspection for disease and

trueness to type by a special team of clonal inspectors supervised by a chief inspector.

Under the Dutch system, any farmer can initiate clonal multiplication, although this is a specialist activity and some 200-300 farmers enter for the highest classification after initiating disease-tested, first- and second-year clones. The Netherlands unlike Scotland and New Brunswick and Prince Edward Island has no selected group of high grade growers. Under the Dutch system quality control is achieved by means of the standards alone and not by means of the growers who undertake the multiplication. The standards are stringent and expensive to adhere to and this ensures that only specialist growers attempt to maintain them.

Once a clone has passed the inspectors and tests as a second-year clone it can be entered for classification at the highest class (S). Failed clones are rejected and cannot be certified.

Following the initial classification of seed there are two separate classification routes which can be followed by the clone. If a clone is sold for further multiplication it is automatically downgraded the next year, and a clone sold and multiplied at each generation will be successively downgraded every year. A clone which is retained need not be downgraded every year. Thus a seed grower can maintain S grade for four generations, and later grades for two generations. This concession on downgrading means that in practice the classification system contains extra grades covering the additional generations where own seed sources are used. These generations are not labelled separately although accompanying documentation will clarify the distinction. The reason for this is to provide some incentive for seed to stay on the same farm and thus avoid the problems of transferring contamination or causing additional damage as a result of dressing and transport. However, it does mean that the Dutch multiplication chain could produce commercial certified seed which is as much as 12 generations old.

A recent modification is the possibility of using micropropagation as a source of disease-free material. This material can be commissioned through micropropagation by any seed grower or breeder and the product of this process is accepted as the equivalent of a second year clone and can therefore be entered for S

certification. This method accounts for only 25% of total material entering the system. The micropropagation is undertaken by NAK on an agency basis, although a cooperative breeder has initiated a similar service in 1987. The procedures and testing to ensure that the product of supervision of micropropagation is disease free is also the responsibility of NAK.

The current NAK micropropagation work is not an official NAK responsibility. It began the work when an approach was made by a group of farmers and breeders for permission to utilize some of the NAK laboratory resources.

The inspection and sealing is undertaken by a team of specialized seed potato inspectors. These inspectors are located at the four regional centers. Ninety full-time inspectors are employed on this work with roughly 400 ha per inspector in the main production areas. They are employed throughout the year performing field inspections and later consignment inspections, sealing and labelling at grading stations of the large seed merchants, and on growers' farms.

The basic seed classes, S, SE, and E, are field-inspected at least four times for trueness to type and for various diseases. The certified seed class crops are subjected to two inspections.

Applications for inspection are submitted in May and field inspection begins in earnest at the beginning of June. If necessary, the inspector may call upon additional inspections. A multiplication factor for each disease found is applied to the percentage of diseased plants so that for any given crop the disease index is calculated. This index must then conform to the disease index for the class entered or be downgraded. The multiplication factors used to calculate the disease index are higher for the second inspection and therefore the farmer has to rogue if he wishes to maintain the class during his second inspection. For the major bacterial diseases a zero tolerance is required for all classes. For blackleg, a zero tolerance is set for classes S, SE, and E. The final inspection is undertaken just before the haulms are destroyed. The class is fixed after all testing is done; the final inspection at sealing does not change the class. If necessary the grower has to re-grade until the inspector is satisfied.

Obligatory top-kill dates are specified by NAK during the growing season. The date of top-kill depends on data collected on the number of colonies of the relevant aphids found in the spring and the data obtained during the growing season from the various aphid traps which are located throughout the seed-growing areas. The decision to impose haulm killing is made by a NAK committee. The top-kill date will depend on the variety and its resistance to virus diseases. Because of reduced aphid population in the last three seasons, the top-kill dates have been delayed significantly. For some varieties no top-kill date has been specified. This signifies a major improvement in the battle against virus diseases by the Dutch industry. Crops which are not burned down in time may be dropped a grade or be denied a certificate altogether.

Because of the way the clonal-selection system operates there are a number of growers maintaining varieties. As a result it is necessary in the Dutch system to maintain a special provision for checking that the seed produced from these seed plots remains true to type. Thus, before receiving S certification, samples are compared with clones from other sources in special trial plots to ensure trueness to type.

Postharvest testing is implemented for all potatoes grown at the S and SE grades. It used to be applied to some 70% of the E grades (the most vulnerable varieties) but because of reduced virus disease this requirement is no longer specified. The postharvest testing involves the removal of eyes from a sample of tubers at harvest and planting them in greenhouses and examining for viruses after three to four weeks. These plantlets are also subject to laboratory tests. Separate samples are taken and tested for blackleg and for gangrene. The crops are then certified subject to final clearance at sealing.

Finally before sale and final sealing, the harvested potatoes are inspected for tuber diseases, shape, and damage to confirm the grade of certification. In addition, any lots which are destined for export are inspected by the PD, the government inspection service.

The NAK also runs trials on the previous year's certification. About 2,000 samples are planted out in a special trial field to give another check on the performance of the certified seed.

However, the results of this check are used simply for the internal use of the NAK and are not made public. Their purpose is to serve as a management control on the procedures used.

As potato cyst nematodes are a very serious problem in some parts of the country, a strict rotational limitation is imposed. Sampling of fields before planting is required for most of the seed potato growing areas, although the extent to which this is imposed varies. Under regulations of the Ministry of Agriculture potatoes may only be grown one year in four, although soil fumigation and nematode-resistant varieties allow shorter rotations. In order to keep close control, a systematic mapping of the production areas is undertaken recording field boundaries, varieties, and fumigation. While improvements in nematode resistance have followed from breeding work, nematodes represent a serious problem for the Dutch industry. Anticipated changes in control on the use of nematicides as a result of concern over environmental effects will increase the difficulty. It is expected that changes in the regulations will lengthen the rotational limit of potato production.

The nematode problem has been largely the responsibility of the PD although the mapping service and regular sampling of fields before harvest is undertaken by NAK. In addition all crops are subject to a check of soil collected below the grader to ensure freedom from potato cyst nematode. This is part of NAK responsibility and forms part of the certification.

The NAK is totally funded by the fees it raises for inspection and certification and for services provided to other parts of the Dutch seed potato industry. However, one half of the value of these fees is subsidized by the Ministry of Agriculture. Fees are charged for field inspection, certification, a gangrene test, and post-harvest control. On the assumption of a yield of 25 t/ha, the total charge for certification works out to just over 800 Dutch guilders per hectare. As the Dutch government subsidizes 50% of this cost, the farmer will pay roughly 400 guilders per hectare. The element of government funding means that the Ministry of Agriculture can continue to play an important overall supervisory role. However, the government has decided to reduce its financial commitment to NAK as part of general cost-saving measures.

Although, it is also insisting that the balance of government support for the NAK remain at 50%, other reductions in government support will place additional pressure on NAK resources and represent a major challenge for the seed potato industry.

Phytosanitary and Related Issues

The national plant protection service is principally concerned with the control of plant diseases and pests within Dutch agriculture. It has laboratories for diagnosis and for the development of tests and other research. It is also responsible for quarantine arrangements and for the inspection of products which are imported into the country and which go for export. The PD's main responsibility in respect to potatoes is the supervision of standards for potatoes which are exported, and it will conduct extra tests for all exported consignments if NAK standards are not specified.

Potato Breeding

The Dutch potato industry has developed over the years a unique system for the breeding of potatoes. While there is government financing for some of the essential, fundamental work associated with potato breeding, the creation of new varieties and their ownership remains in the hands of private individuals or companies. Thus the sole role of research organizations with state funding is to provide plant material for the use of private breeders as well as any necessary support services.

Traditionally, the fundamental research in breeding has been undertaken at the Institute for Plant Breeding (IVP). The IVP is a department of the Agricultural University at Wageningen. The institute is concerned with both teaching plant breeding and with research, and its research work is principally of a fundamental and an academic nature. It has been largely concerned with studying the genetics of potatoes and of incorporating the characteristics of some primitive species into material which might be used by others in applied breeding programs. The IVP also has

responsibility for the Dutch interests in the joint Dutch/German gene bank at Braunschweig. The work which is undertaken at the university is determined by the university department itself without any formal influence on the part of the industry or the Ministry of Agriculture.

The development of novel methods of breeding has meant that work from other institutes, in particular the work which is undertaken at the Research Institute ITAL, has become relevant to the potato breeding program. There has been much concern as to how one might integrate the work of ITAL into the overall organization of research on potato breeding undertaken in The Netherlands. There has been some argument that this work should be the responsibility of the Foundation for Agricultural Plant Breeding (SVP). The SVP is one of the agricultural institutes which belongs to the Directorate for Agricultural Research (DLO) of the Ministry of Agriculture. The SVP reports to the DLO and in the past has been wholly financed by government funds, although in recent years the targets have been set for industry-financing. Now the SVP has a substantial element of industry funding which has brought some change in its policy. In particular, the work is being orientated more towards fundamental work because such work is expected to bear very directly on the future direction of potato breeding. As will be indicated below there are also changes in the policy for distributing material to the breeding sector.

While the SVP is involved in breeding work on a number of arable crops, its main efforts are devoted to potato-breeding work. Its work has been largely concerned with applied breeding with the intention of producing material for the use of private breeders. While it is largely funded by the Ministry of Agriculture its board includes representatives nominated by the various groups with an interest in breeding and which now provide some of its funding. There are representatives from the plant breeders' association (NKB), the farmers' organizations implementation (*Landbouwschap*) and one representative each from the Ministry of Agriculture and the Agricultural University. In addition there are advisory members from other related research institutes. By custom the chairman of the board of the SVP is nominated by the NKB.

As a result of this form of organization the potato industry has a very strong influence over the direction of work undertaken by the SVP, although the Ministry of Agriculture, as an important source of financing, also plays a major role. The requirements of the industry are fed into the strategic planning of the SVP through formal contact with the breeders and with the Dutch Potato Association (NAA), a group which includes the heads of all the representative organizations concerned with the potato industry and which meets annually to discuss potato-breeding policy.

The SVP makes material available to the private breeding sector in the form of (a) parental material for use in crossing programs and (b) seeds and first-year clones for use in selection programs. Parental material has only been officially available since 1967, the year of the Dutch plant variety rights legislation. Private breeders make use of this parental material in their own crossing programs, often incorporating their own collection of breeding material.

The handing out of seeds and first-year clones for selection reveals a very interesting feature of the Dutch breeding system. There are now roughly 100 breeders of potatoes in The Netherlands, but only a small proportion of them undertake their own crosses; the majority select material from crosses made by others, so while they are referred to as "breeders" they may be more correctly referred to as "selectors." Any of the selectors who identify a new variety with characteristics which have commercial value, and who succeed in getting that variety through the various industry-organized trials, can claim plant variety rights for that variety.

In sum, the Dutch private, breeding industry has produced three categories of potato breeding organizations. First there are the major potato-breeding organizations with potato-breeding stations and formally organized selection groups. Within this group there are six major organizations of which one deals exclusively with the breeding of new varieties for the starch industry. All of the others are owned by, or very closely associated with, major seed potato exporting organizations and with the exception of one, all are constituted as cooperatives. They have their own breeding stations, employ their own plant breeders and

have their own facilities for crossing and for undertaking certain disease tests. They maintain their own bank of parental material, some of which will be collected independently from SVP.

Some of the selection work is undertaken on the research station, although attached to each of these stations are groups of selectors who may or may not be involved in their own breeding work.

A second group is composed of the smaller and medium-sized breeding organizations where in most cases, the breeder undertakes his own independent breeding program using his own, or SVP parental material. These individuals may also be involved in selecting on behalf of the breeding stations mentioned above. Some of these breeders have grouped together to provide certain services which they require. These groups are increasingly becoming absorbed into the major breeding organizations.

Finally, there are those persons who undertake no crosses, but as we have explained, just undertake selection from breeding work undertaken by others. In most cases these selectors are working or retired farmers who undertake this activity as a hobby. Many of these have been involved in the production of potatoes for many years and it is in this group that the majority of breeders in The Netherlands can be included.

The great advantage of the Dutch system is that it is able to cope with a very large number of seedlings and first-year clones derived from a crossing program. In total it is estimated that more than 1.2 million seedlings are screened annually in The Netherlands. This greatly increases the chance of successful selection of a clone. However, the change in funding of SVP has brought a change of emphasis. The industry now controls more of the financing and has more power over the allocation system and breeding policy. The SVP is now working more in the fundamental research area and focusing on the handing out of parental material to the private breeding stations. This means that the amateur or hobby breeders are more dependant on receiving their material from the big breeding stations and groups than before.

The other major strength of the Dutch system for the organization of potato breeding is that the potato breeding effort is very market orientated. The work done at the state-funded

SVP is very strongly influenced by the breeders and their agents who have a very clear idea of the nature of the demand for potato varieties. The commercial breeding and selection is to a large extent under the influence of the large seed potato exporters who either have their own breeding stations or act as agents for the potato breeders. They can influence the selection criteria on the basis of their experience of the type of potato which meets certain market requirements. The breeders' agents also have the resources to be able to provide the necessary back-up in terms of specialist testing should this be required. The PD provides testing services for private breeders on an agency basis to cover wart disease, and potato cyst nematodes, although some breeders have their own facility.

The breeders' agents also have the facility to subject any promising varieties which result from the initial selecting procedures to extensive trialing on farms domestically, and where appropriate, overseas. Also where necessary, the services of NIVAP are used to assist in the initiation and management of trials on an official or unofficial basis in potential markets.

New Variety Assessment

Because there are so many potential varieties emerging from the Dutch system, the Dutch have devised a formal procedure for assessing the ones that are most promising and the ones which can be grown in The Netherlands, either for domestic or export markets. This assessment process involves both unofficial and official trials. After the fifth year of screening a private breeder will be in a position to nominate the most promising varieties. These will be submitted to a harmonized national selection system (preliminary trials) together with material from all of the private breeders in The Netherlands. These two years of preliminary trials are organized by COA, a long established organization with a responsibility for promoting the production of new varieties from The Netherlands. It has also worked as an extension service to improve the work of private potato breeders and to help make the link between the public and the private sector. It is funded by a levy on breeders and funds are also allocated by the NAK and the *Landbouwschap* but some of

its costs have been met by official government organizations.

The preliminary trials provide a means of identifying which varieties nominated by the whole of the private sector will go forward into the official potato variety trials. Thus the pre-trials for the important sector and the organization which runs them must be beyond reproach in terms of its objectivity. Thus, only senior staff from RIVRO, the official government institute for the testing of agricultural and horticultural varieties, are involved in administering the pre-trials. In fact, participation in the preliminary trials are voluntary and the breeders are not required to accept the decision of the preliminary trials although most of them do. As RIVRO staff run the official trials, it is highly unlikely that varieties which by-pass the pre-trials are likely to be successful.

These trials are conducted on a number of special sites within The Netherlands which represent different environmental conditions. No trials are undertaken in export-market environments, although data on performance in export markets can be made available to support the case of a promising export variety. While this is seen as a weakness by some, each of these varieties are being selected with the purpose of multiplication in The Netherlands and therefore it is vitally important that they perform well in Dutch conditions as well as in other markets. Roughly 200 clones are entered each year into preliminary trials while only 20 of these are submitted to official trials after the end of two years of trialing.

The official trials are run by the *Rassenlijst* Committee and the results determine the varieties which can be entered on the national list and also can be recommended to growers of seed potatoes. The *Rassenlijst* Committee comprises persons with substantial experience and high standing within the Dutch potato industry. The official trials take two years to complete and incorporate one specific set of trials for the purposes of selecting varieties to go on the official register of varieties. The only criteria for the last is that the varieties meet the requirements for distinctness, uniformity, and stability. Once this status is achieved the variety may be entered on the register and the breeder is granted plant breeder's rights.

The results of the trials provide information necessary for evaluating cultivation and use, and these form the basis of the results published annually in the *Rassenlijst*.

In the *Rassenlijst* varieties are classified according to recommended use. The table below indicates the classifications.

The categories are:

- A variety recommended for general or fairly general growing
- B variety of limited importance, or recommended for special circumstances
- O variety of minor importance, no longer completely described
- N new, recommended variety
- T accepted new variety with sufficient agricultural value
- UB variety mainly for export, but also admitted for home use
- U variety only for export, beyond Common Market countries.

The National List incorporates all of these varieties plus any which might be classified as O, or UB but which are not described (another 70 varieties). Most of these latter varieties are classified as O and UB and are for export markets.

The *Rassenlijst* is a very important publication in the Dutch potato system. For a variety to get into the *Rassenlijst* represents the pinnacle of achievement for the breeder, and it opens the way for general acceptance of the variety in the industry and for its production for domestic and foreign markets. It means that this variety has outperformed the many thousands of clones of its generation and because of its superior characteristics is acknowledged "officially."

Domestically, the *Rassenlijst* (or a summary) is widely read by Dutch farmers and consequently it serves as an important means of promoting the variety and its utilization.

Some changes in the Dutch potato system of variety assessment are foreseen. First the COA work will be taken on by RIVRO, and COA will thus virtually cease to have a role. Second, the two years of pre-trials previously supervised by COA will be reduced to one. Thus breeders will submit 50 varieties and not 200. Thirdly, there are plans for RIVRO's costs to be recovered from the industry by fees. This

will add to the cost of private breeding. Finally, there are plans to amalgamate RIVRO with another institute to form a new organization with responsibility for all crops.

Release of Material Into the Multiplication System

Because of the system of private breeding and the substantial proportion of seed which is subject to monopoly control, the decision on the quantity of material to bulk-up is at the discretion of the breeder's agent. The breeder or breeder's agent maintains the variety and initiates multiplication through contracts with seed potato growers. A similar system of contract-growing exists for all the free varieties but here farmers can also decide to grow for sale at spot prices. Individual growers can maintain their own plots of a free variety and use these for clonal selection. There is no control over the amount of material released into the system. The NAK will inspect and test clonal material on request.

One factor which has influenced this pattern of multiplication has been the generally very small size of individual farm holdings and the resulting difficulties which the owners have in marketing seed potatoes themselves. The Dutch seed potato grower is only concerned with the production of seed potatoes and not with knowing what market they can be sold on. The marketing activities have been assumed by the major potato cooperatives which have emerged, and also by a number of private companies. The cooperatives have a long tradition in Dutch agriculture and have a very important share of seed potato sales. A number of amalgamations have left three cooperatives (Agrico, CEBECO, and ZPC) as the predominant cooperative organizations with major interests in both seed- and ware-potatoes. Each of these organizations have reached the size where they can undertake all those activities in the domestic and foreign markets which are necessary to promote both seed- and ware-potato sales. These organizations also have breeding organizations and act as agents for other private breeders. They are thus in a very important position within the Dutch seed potato industry. The private companies are also very

important and operate on a basis similar to the cooperatives, by obtaining their seed requirements contracts with growers.

Of course, the freedom to multiply what they wish means that there are dangers that, overall, total supplies might exceed that which is justified by market circumstances. The Dutch are well aware of this problem and have instituted a market support mechanism in order to cope with any possible problems. This arrangement is totally funded by the industry itself and as such does not represent a major distortion of market forces. The basic philosophy behind the Dutch approach to both seed- and table-potato production is that the market should be allowed to operate as freely as possible without any interference from outside. Consequently, they have great faith in the ability of the market to resolve any major difficulty without resorting to imposing any national regulations. They consider that everybody is aware of the possible dangers of producing too much of any one variety and that this will bear heavily on the decision they make as to how much to multiply.

Market Regulation

The seed potato intervention agency STOPA is funded entirely from levies on producers and wholesalers. This agency has the responsibility of setting guaranteed prices for different grades of seed potatoes. The level of the guaranteed prices has been established at roughly two thirds of the cost of production. However, this figure is somewhat arbitrarily set as there is no formal method of assessing on a representative basis what the average costs of production might be. The aim is to put a bottom into the market at a level which is sufficiently below production costs to ensure that no individual farmers will be attracted to grow for intervention. One of the major objectives of the STOPA scheme has been to provide a market for those varieties which are grown specifically for export and for which no market can be found. It is very important in a seed potato system which is so orientated towards exports, to have assurance of this cover for varieties which would have very little or no value on the home market. The availability of STOPA's intervention buying

reduces the risk for those producing new varieties specifically for export markets. This risk is shared by the entire industry.

Also, a large volume of free varieties is sold into STOPA in years when seed prices generally are very low. This is inevitable in a sector where everyone is entirely free to initiate clonal material for certification. In effect STOPA acts as a safety valve, but the costs of maintaining this safety valve can be large. The 1985 season caused enormous problems because of the extent to which excessive seed supplies lowered prices, and almost 200,000 ton of potatoes were entered into STOPA. However, this is a most unusual occurrence and the average level of sales into STOPA has been substantially less than this amount. The exceptional situation following the 1985 harvest has brought a reconsideration of the nature of funding and levels of guaranteed prices which should be offered to the seed potato industry.

The guaranteed prices are established for different size grades and for different classes of seed. STOPA will only purchase potatoes on specified dates of the year to ensure that intervention is the last resort for seed sellers. The potatoes taken off the market are either resold on to non-competing markets, or else denatured.

The funding of STOPA is derived from a basic area levy (originally 250 guilders per hectare in 1986) and a sealing charge which varies according to the size grading of the consignment. In addition, a levy is charged to all growers of specific varieties if those varieties are sold into STOPA. The size of this charge will depend on the volume of sales to STOPA in the previous year. This formula encourages the industry to be conscious of the potential market requirements of a variety. In addition, there is a provision for a "calamity" levy to be charged should trade be disrupted for any given reason. This provision comes into effect when surpluses are substantial and depends on the size of the STOPA purchases. Thus, for example in 1986 the original guaranteed price arrangements had provisions for a calamity levy of 400 guilders/hectare to be charged if the total amount sold to STOPA exceeded 60,000 tons. The levies due from farmers are collected by the *Landbouwschap*, and the NAK is responsible for the supervision of the buying-in of the different grades of seed potatoes and also the

organization of their disposal or denaturing. In fact, the potatoes do not leave the farm and the NAK role is to ensure that STOPA potatoes are genuinely disposed of in non-competing markets.

The very large quantities sold into STOPA in 1985 meant that the total reserves of STOPA were used up. The 1986 levies were revised to ensure that adequate funds were available to cover the losses of the previous crop as well as the requirements for the new crop. Faced with the alternative of increasing levies or decreasing guaranteed prices, the industry chose the former indicating the insurance value of STOPA.

Seed Potato Promotion

The existence of privately owned varieties means that within the Dutch system there is substantial incentive to develop the market for these varieties. Thus, the major breeder's agents develop marketing and sales strategies at home and in export markets. This involves a wide range of activities from the trialing of new varieties, various extension activities, and work in support of sales. Much of the work will be carried out through agents in the export markets.

In addition, the industry funds an organization to promote Dutch potato seed. The organization (NIVAP) has the responsibility of organizing trials for the establishment of Dutch varieties on national lists, and for providing general support in the form of technical advice which might assist the acceptance of Dutch varieties. It will also help in the assessment of the potential of new varieties in foreign markets and in the administration and organization of promotional efforts to ensure that the virtues of all Dutch potato are well known in the market. Its role in promoting free varieties is important because there is relatively little incentive for the promotion of these varieties in export markets due to the expense and to the wide range of potential sources of these varieties in The Netherlands and other countries.

Again this organization is fully funded by the Dutch potato industry as a whole from its levies on farmers (collected through the *Landbouwschap*) and traders (collected through

the seed potato trade *Bedrijfschap*) and channelled through the PCC.

Also, substantial assistance is given to the development of Dutch exports through the ministries covering economic affairs and development aid. Both of these Ministries offer assistance either in promoting Dutch goods or in providing the infrastructure to facilitate trade. The extent of the assistance through development aid is difficult to ascertain, although anecdotal evidence suggest that projects such as seed potato storage facilities have figured as part of Dutch aid.

Other Support Activities: Credit and Insurance

In The Netherlands there are no special provisions for the potato industry in relation to either credit or insurance. Credit is available at market rates although there are European Community and national schemes which serve as investment incentives. The locally-based co-operative banks under the RABO umbrella serve an important role as a source of credit to the industry, although there are many other credit institutions involved in lending to the industry. Because of the volume of foreign sales, export credit is particularly important, and the banking sector has developed a wide range of schemes to assist in this essential support area. An interesting feature is the willingness of the Dutch banks to consider providing credit to the customer and to the exporter.

10. Background to the British Potato Industry

Great Britain includes the countries of Scotland, England, and Wales. Within these three countries the main concentration of certified seed potato production is in Scotland which accounts for about 90% of British certified-seed output. Seed potatoes are also produced in Northern Ireland, the fourth major political region of the United Kingdom. The Northern Irish potato sector is administered separately from that of Great Britain and will not be covered by this report.

Production, Areas, and Yields

In 1985, potato production in Great Britain was estimated to have attained 6.6 million tons, ranking it about ninth in the world. More than 80% of total potato production is found in England and Wales, with concentrations in eastern counties and in the West Midlands. There are some 18,000 producers growing potatoes and the average area grown in 1986 was calculated to be 7.7 ha in England and Wales, and 11.9 ha in Scotland.

Potato production has been fluctuating around a level of about 6.5 million tons since the mid 1960's with substantial variations from year to year (Appendix 1, Table 1). The most dramatic variation from this level came in the years 1975 and 1976 when drought resulted in very severe reduction in production.

Potato area is controlled by quota and consequently has been subject to official influence. Plantings have contracted steadily and in 1986 were almost one half of the levels in the mid 1950's (Appendix 1, Table 2). Area contraction has been inevitable given the substantial increase in yields/ha the only modest increase in domestic consumption levels and the few overseas market opportunities. The general deterioration in the financial situation of other agricultural crops in the second half of the 1980's has not affected the area of potatoes under cultivation.

Since the ending of the Second World War, the nature of potato production has changed dramatically. A succession of new varieties arrived on the market from the 1960's, the fruits of a substantial state investment in potato breeding in the post-war period. These varieties significantly increased yield and this, combined with an improvement in the general management of the crop and improvement in seed quality, has led to an increase in the five-year moving average yields from 18 t/ha over the period 1955-59 to 35 t/ha over the period 1982-86 (Appendix 1, Table 3). During the two drought years of 1975 and 1976, yields dropped to below 22 t/ha and this experience has prompted many to invest in irrigation systems for use during those years when moisture deficiency is a problem. As a result, it is highly unlikely that similar dramatic reductions in supplies will be repeated.

There has been a move towards greater concentration of production in those areas of the country which are more favorably placed in terms of production capability and markets, although to a certain extent, this adjustment has been restricted by the quota arrangements over the years. Modifications in the administration of quotas have attempted to allow for adjustment required by market forces.

Varieties

There is a very substantial demand for early maturing varieties within the United Kingdom and some 31% of the total crop is now classified as first or second earlies. An important feature in recent years has been the emergence of a number of varieties, of mainly Dutch origin, which are classified as second earlies and which produce potatoes of good quality for sale on the market until Christmas. The varieties Estima and Wilja now account for some 16% of the total British area. The United Kingdom-bred varieties, Maris Bard and Pentland Javelin, are also important early varieties and account

for 7% of the total area planted. These varieties emerged from the State potato-breeding stations in the middle of the 1960's, and early varieties bred prior to that, now represent little importance.

In the maincrop sector a similar pattern has emerged with most of the traditional varieties disappearing with the exception of King Edward. This variety now represents a relatively small area but still has a market niche because of its attractive red blush skin characteristics. A variety with similar tuber color, Cara, bred in the Irish Republic and with greater drought resistance, has largely displaced King Edward production over recent years. The principal maincrop varieties are Maris Piper (14% of total area) and Desiree (11%) (Appendix 1, Table 17), although both of these varieties have lost share to the "second early" varieties mentioned above.

The old Dutch variety Record is important and accounts for 11% of the total area planted in 1986; it is sold almost exclusively for potato chip manufacture.¹ This variety has secured a special position in the British potato industry due to the widespread use of contracting production which has assured it a stable share. Because potato chip companies buy few open market potatoes, the sector is, to a large extent, separate from the rest of the British potato industry.

French fries manufacturers take a number of varieties which are generally available on the British table market, although meeting french fries specification has been difficult without the wide availability of varieties which produce large and long tubers such as Russet Burbank. Pentland Dell is most similar in terms of shape and dormancy and has an important position in serving late, storage-season processor demand. Recently, the largest french fries manufacturer, McCain, has introduced Russet Burbank, and has rapidly converted the bulk of its contract purchases to this variety. In the early and middle 1970's, there was a rapid increase in the production of the variety Pentland Crown, but this has fallen away as its variable cooking qualities presented marketing problems. The table market has become substantially

influenced by the requirements of supermarkets. These outlets want a well shaped, evenly graded pre-packing potato with the kind of skin finish which looks attractive after washing. Maris Piper is the variety which best meets this requirement. However, many potatoes are sold through more traditional channels and here quality has been less critical. The vast majority of table potatoes sold in the United Kingdom are sold under the designation "reds" or "whites" with no variety labeling.

Importance of Potato Production

Potatoes represent roughly 5% of the total farm output.

Consumption

As in most countries, estimates of the levels of human consumption of potatoes are based on residuals after taking account of other utilizations. Consequently, there is some uncertainty associated with these estimates. During the 1980's, there has been a gradual increase in consumption from the low levels which followed the very high prices of 1975 and 1976. Consumption was estimated to be 111 kg/head/annum in 1985, some 11 kg above the level six years previously. This improvement has accounted for by a wide range of factors among which the growing realization that potatoes are a healthy part of the diet, increased purchases as a result of high levels of unemployment, and continuing buoyancy in fast food sales (french fries), are believed to be important.

Utilization

There is no utilization of potatoes for industrial processing in the United Kingdom. In the 1985 crop season 72% of the total output was sold as table potatoes, although a small part of this quantity is believed to be used as an ingredient in certain processed foods and catering preparations. French fries account for 13% of total utilization, potato chips 11%, and canned and dehydrated 4%. Of the 6.6 million tons

¹ The terms french fries and potato chips are equivalent to the British terms chips and crisps respectively.

produced in 1985, 63% went to human consumption in fresh form, 20% into processed products, 9% for use as seed, 2% were taken off the market as part of the intervention arrangements, and 6% were classified as waste.

Trade

Because of its island status and the high cost of transporting potatoes a very high proportion of domestic requirements are met from the British potato crop. However, there are some important categories of regular imports. During the latter end of the storage season, newly harvested potatoes from North Africa and the Mediterranean region are imported and sell at a large premium over the domestic, stored crop. During late May and June, imports also become available from western France, and these compete with the domestically-grown early crop. Over the last ten years, early potato imports have averaged about 300,000 tons.

There are other regular imports of table potatoes, but these are of very small value, and are usually for very specific purposes (e.g. canning or late season processing). The quantities imported depend on the availability and price of potatoes from the home crop, but rarely exceed 100,000 tons. Seed imports are relatively small, representing some 20-25,000 tons/annum. These comprise seed potatoes from either Northern Ireland or from The Netherlands. The import of maincrop table and seed potatoes into the United Kingdom has only been freely permitted from other member states of the EEC since full accession to the European Economic Community in 1978. Since that date there have been no substantial inroads into the British market, although many new varieties being multiplied on contract in Scotland were bred by Dutch organizations. The most rapidly expanding sector of imports has been in the form of processed potatoes and, in recent years, the volume has approached 400,000 tons. The bulk of this is french fries and dehydrated potatoes, and reflects the problems which the domestic processing sector has had in meeting this demand, given the higher prices of potatoes in the United Kingdom compared with those of continental Europe.

Exports of potatoes from Great Britain are relatively modest. Only small quantities of table and processed potatoes are involved. The most valuable exports are those from the Scottish seed crop. These amount to between 50-85,000 tons over the last eight years, with the most important markets being Algeria, Morocco, and Portugal (Appendix 1, Table 8). The bulk of recent buying interest is from North Africa rather than from northern Mediterranean countries.

The seed export trade is dominated by sales of the variety Desiree with some of the most important Scottish seed potato customers buying this variety exclusively. In most countries in the world, seed production of Desiree has been subject to licensing and control by its breeders, the Dutch cooperative ZPC. However, in Great Britain the variety fell foul of a technicality in the administration of the plant breeders' rights legislation and consequently was not granted plant breeders' rights in the United Kingdom. As the certification agency would inspect any variety for certification if it was requested (as long as it was on the National List of the EEC Common Catalogue), the multiplication of this variety fell outside the control of its Dutch breeders and developed rapidly.

Prices

Despite the control over the area cultivated, there is still a fairly substantial fluctuation in annual production as a result of variations in yield and plantings by producers who are not registered and subject to quota control. Until recently it was a common practice to plant in excess of quota on a speculative basis because the penalty for exceeding the quota was relatively small. New regulations introduced in 1985 have substantially raised the level of excess quota levies and thereby controlled much more tightly the quota area.

Because of the intrinsic volatility of prices, measures to reduce the incidence of low prices have been introduced since the mid-1930's when the Potato Marketing Board (PMB) was founded. In addition to quota, supplies have been regulated by the prescription of minimum size rules, import controls, and intervention.

This intervention has been directed towards achieving certain minimum guaranteed prices. Entry into the European Community, with the condition of free trade between members, has meant that the price levels which could be sustained by such measures, had to be substantially reduced because of the risk of attracting imports. As a result, the level of support has been reduced and the mechanism for providing that support has been amended. The volume of imports of table potatoes is limited by the varieties available in neighboring countries. Bintje, the predominant variety of The Netherlands, Belgium, and France has proved unacceptable to British supermarkets, principally because of its skin finish.

A futures market exists and has proved very successful with turnover increasing in each year of its operation. This market allows producers, traders, and processors alike to manage the extent to which they are exposed to price risks. The market also serves a very useful economic function by providing an assessment of what those who participate in the market anticipate to be the future level of prices. The success of the market in this respect depends a great deal on the quality of the information. Even though Great Britain has a relatively small number of potato producers and the Potato Marketing Board has substantial powers to collect information, accurate and reliable market information still proves a difficult area, and inconsistencies arise.

The Processing Sector

The potato processing sector of Great Britain utilizes some 1.4 million tons of potatoes with the bulk of these being grown in the United Kingdom. The largest potato-processing sector manufactures potato chips, although recent growth in frozen or chilled french fries has brought the utilization of this sector to similar levels (roughly 600,000 tons/annum). The potato chip sector is not subject to any substantial competition from importers because of the transport costs. However, both the dehydrated and french fries sectors have been subject to considerable competition from Dutch manufacturers.

Market Infrastructure

The marketing of the table potato crop involves primary wholesalers in the rural areas and secondary wholesalers in the main urban markets. Over the last 15 to 20 years there has been a growth in direct sales from primary wholesaler to retailer. In particular there has been investment in pre-packing facilities on the part of both cooperatives and private companies to meet the growing demand for pre-packs among multiple stores. The primary wholesalers are also important suppliers to processors, although there is also a substantial investment in grading facilities on farms and many processors will contract directly with producers for graded supplies. The majority of potato chip supplies are purchased on the basis of fixed-price, pre-season contracts. In the french fries sector, where similar potatoes to those being sold for table demand are required, spot purchases tend to be the most important procurement method, although most processors will purchase a proportion of potatoes on fixed price contracts.

In the seed sector there are a large number of specialist merchants as well as producers who own their own marketing business. These would normally sell to growers in England and Wales through their agents in those countries.

Market Regulations

The Potato Marketing Scheme is the responsibility of the Ministry of Agriculture, Fisheries and Food (MAFF) although the Potato Marketing Board acts as the principal agent for its administration. MAFF makes the principal decisions on the scheme parameters following discussion with the PMB and representatives of growers, wholesalers, and processors.

The Potato Marketing Board comprises representatives of producers from all regions of Great Britain plus three independent members nominated by MAFF. The Board has many committees which look after various aspects of its work. The Board now offers pre-season contracts at prescribed target prices and aims to have up to 10% of total crop under its control through these contracts. Should market prices

exceed these target prices then growers are released from their contractual commitments. If prices are below these levels then they may sell to the Board. The potatoes purchased by the PME may be either denatured on the farm (by dyeing) or sold for stock feed. The extent to which the MAFF funds the scheme has been reduced by recent revisions in the regulations. The aim is that by 1989 the industry will have raised sufficient funds by levies to enable the scheme to be self-financing. In past years, when the old guaranteed price system was in operation, government assistance for this scheme could be considerable.

Seed potato growers may take advantage of this scheme should they wish, although the contract prices are considerably below seed-potato prices. Many seed potato growers in Scotland expect to sell oversized potatoes (seed tops) on the table potato market, and hence the market regulation arrangements have some relevance to them.

The major problems encountered by the market regulation system are those which follow from distorting market forces which have introduced some rigidity into the system so that the adjustments demanded by market forces cannot take place at the pace required. Another major problem has been the extent to which the processors of french fries and dehydrated potatoes have suffered because prices in the United Kingdom have been sustained at levels which are higher than those in neighboring countries with free market circumstances. This has led to a very rapid development in imports of frozen french fries into the United Kingdom.

11. The British Seed Potato System

General

It is estimated that in 1985 the British certified seed potato crop yielded some 780,000 tons of seed potatoes. The vast bulk of this is produced in Scotland. Of this total quantity some 405,000 tons was available for seed use after taking account of table-stock sales and storage losses. Thus, Scottish seed potato producers also have a very substantial interest in providing table stock, with recent economic studies of the seed potato enterprise suggesting that the non-seed fraction of the crop can account for something like 40% of the total revenue of these farmers. In a system distinct from that of Canada, a premium is paid for fairly small size seed tubers because whole seed is used and tubers are never cut. Thus, while Canadian seed growers need to allow their potatoes to bulk for a seed crop, this is not a necessity in the British situation.

From estimates made by the author it is estimated that each year only 66% of the total seed requirement on British farms is met by certified seed (Appendix 1, Table 17). In the United Kingdom there is no requirement to grow certified seed and indeed the extension services have not discouraged the use of once-grown seed, providing that it is of varieties with high disease resistance. The basis of the estimate is outlined below for 1985 and a more detailed table, including comparisons with The Netherlands and Canada, is given in Appendix 2.

Table 12. Certified seed potato use by British producers, 1985

Total area planted	179,000 ha
Average seed rate	3.1 t/ha
Total seed requirement	554,900 t
Actual certified seed used	365,000 t
Estimated per cent planted with certified seed	66%

These figures are based on Potato Marketing Board estimates of seed usage and trade and data from the survey of seed potato costs in the season 1984/85 conducted by the North and East of Scotland Colleges of Agriculture. The Scottish Seed Potato Development Council dispute the PMB data on seed movement and usage and suggest that the proportion of certified seed used is higher.

Seed Trade

Exports of seed from Scotland vary substantially from year to year with the average volume over the period 1980-1986 representing 61,000 tons. The largest volume of export occurred in 1984 when 84,000 tons were exported. Prior to 1972/73 seed exports from Scotland averaged roughly 15,000 tons/annum. The growth followed the availability of the variety Desiree, and the development of a substantial market in North Africa. Appendix 1 and Table 8 gives the total UK exports by destination including those from Northern Ireland. Scottish seed potato exports are subject, in the regions surrounding the Mediterranean, to competition from potato seed from The Netherlands, France, Northern Ireland, and Irish Republic.

Traditionally a large part of the Scottish seed potato export trade has been handled by a relatively small number of exporters, most of whom are based in the traditional importing ports of London or Liverpool. These companies became involved in exporting as part of the reciprocal trade between the United Kingdom and the countries bordering the Mediterranean. United Kingdom seed potato varieties were sold into these regions for production and harvest during the early spring period, and subsequent export back to the United Kingdom as early potatoes. This reciprocal trade was based on UK varieties familiar to British consumers. In recent years a number of Scottish based

organizations have become more involved in exporting directly.

As noted above, seed potato imports are between 20-30,000 tons and originate from Northern Ireland and The Netherlands.

Organization

The institutional framework of the British seed potato industry involves a wide range of different organizations, each with its own area of responsibility. The picture is rather difficult to describe because of the division of responsibility for areas such as agricultural research, agricultural extension, breeding, certification, and plant health matters between Government Departments covering Scotland, and Government Departments covering England and Wales. The key government departments are the Department of Agriculture and Fisheries for Scotland (DAFS) and the Ministry of Agriculture, Fisheries and Food (MAFF). On all matters concerning seed potatoes DAFS is considered to be the lead department. The Seed Potato and Plant Health Branch of DAFS has responsibility for all aspects of seed potato production and certification, although the certification itself is largely undertaken by the local agricultural officer of the Department. These officers have a wide range of general duties implementing a range of schemes and policies affecting agriculture for the Department. In Scotland scientific support for the certification scheme is provided by Agricultural Scientific Services (and widely referred to as East Craigs, the headquarters of the service). East Craigs has a central position in relation to the administration of many aspects of the seed potato system. Historically it has been involved in a wide range of seed testing activities in support of various extension services. At East Craigs, distinctness, uniformity, and stability (DUS) and variety commercialization and utilization (VCU) trials are undertaken to establish eligibility for entry of potatoes on the United Kingdom National List of Varieties. Also it is an important center for the supervision of plant health issues in relation to potatoes, including import and export requirements of seed potatoes.

East Craigs has two quarantine units for accepting advanced breeder selections and

primary breeding material. All the breeding material coming into the United Kingdom from other countries is subject to intensive testing within this quarantine unit. In addition, East Craigs has responsibility for maintaining free varieties, and over the years many traditional varieties have been freed of virus and other diseases as a result of meristem culture. East Craigs also supplies control varieties to other DUS and VCU trial sites in Great Britain.

East Craigs is also responsible for the issuing of disease-free material to the top of the multiplication pyramid. This used to involve virus-tested stem cuttings but now initial stocks are generated by micropropagation. DAFS provides all of this initial material, but there are a number of private sector laboratories who also use micropropagation to build up stocks. At East Craigs are the disease-testing facilities and it is here that the training of the staff responsible for field inspection as part of the certification exercise is undertaken.

The agricultural officers who undertake inspection are supplemented by temporary staff recruited for each inspection campaign. They are given three weeks training if it is their first assignment, and one week refresher training if they have been engaged in previous years. In England and Wales the Plant Health Administration Unit of the MAFF is responsible for certification. The unit employs its own full-time inspectors who divide their time between seed potato certification and other plant-health work, covering imports and other commodities.

At the technical level there is a committee which considers a number of certification issues which are of relevance to the certification agencies and to the Department of Agriculture for Northern Ireland (which runs a separate seed certification scheme).

There are two organizations which have claim for certain industry responsibilities in relation to the seed potato industry. First, the Potato Marketing Board covers the whole of Great Britain and provides a broad range of services, most of which are directed towards the table-potato grower and market. The exception is the interest of this Organization in the development of seed potato exports from Great Britain. The PMB is funded by levies on the area of potatoes grown, and its principal activity is the administration of the Potato Marketing

Scheme as described above. Other functions involve promotion, information services, and some research and extension activities.

Second, in 1982 an organization was specifically set up to act as a central body for the Scottish seed potato industry. This organization, the Scottish Seed Potato Development Council (SSPDC), has the power to collect levies from all seed producers and to provide a range of services for the sector. This organization has relatively modest financial resources but it has as its central focus the responsibility to promote Scottish seed potato use in England and Wales and in overseas markets. While the Potato Marketing Board is a producers' Organization the SSPDC is best characterized as an inter-professional body with both trader and grower representation.

Until 1987 there was yet another organization with an interest in developing the market for seed potato varieties which were widely grown in Scotland. This organization, the National Seed Development Organization, had the responsibility for promoting all state bred varieties, many of which originated from the Scottish Crops Research Institute. This organization was privatized in 1987 and passed into the hands of Unilever PLC.

Finally some mention should be made of the different trade associations which represent both wholesalers and growers. Apart from representation these organizations are not involved directly in providing support services to the industry, although they are directly represented on the Potato Marketing Board and on the Scottish Seed Potato Development Council. The virus tested stem cuttings (VTSC) Growers Association represents the growers of the high grade seed at the top of the multiplication pyramid. In 1984, at the instigation of the SSPDC, a VT growers' cooperative was established with the prime purpose of regulating the supplies of high grade seed available to meet targets for supplies further down the multiplication chain. Some 60% of the total VT area was under the control of this cooperative and the 1986 SSPDC annual report indicates some degree of success in meeting targets.

Another organization with some role to play in the British seed potato industry is the National Institute of Agricultural Botany (NIAB) which conducts variety-assessment trials

principally for the benefit of the grower of table stock potatoes in England and Wales but also as a service to potato breeders. Similar trials are undertaken in Scottish conditions by the Scottish Colleges. The Plant Variety Rights Office is part of the Ministry of Agriculture and covers all aspects of plant variety rights. This office is on the same site as the NIAB and consequently trials covering national listing and acceptance for plant variety right can be closely coordinated. However, the main center of coordination in relation to potato trials is based at East Craigs, the headquarters of the Agricultural Scientific Services of the DAFS.

Table 13 gives an outline of the various organizations with the responsibilities covering the various support services required by the seed potato industry.

Seed Potato Certification

Seed potato certification originated from a requirement to introduce potato varieties which were immune to potato wart disease. This requirement was introduced into the certification system by the various agricultural authorities to assure buyers that the varieties were pure and true to type. In Scotland, this requirement began to be introduced in 1918, and by 1922 two more certification levels (H, high grade and TS, true stock) had been introduced. Standards of 5% and 10% of plants were established for the two grades for leaf roll and severe mosaic virus. In 1936 the TS grade was discontinued and three new grades established, SS, A, and H, with SS having the highest standards.

During these years the certification was undertaken by the Board of Agriculture for Scotland, later to become the Department of Agriculture and Fisheries for Scotland. During the 1950's the DAFS pioneered the development of virus-tested stocks and more recently virus-tested stem-cut stocks. Similar developments (paralleling the process described above) took place in England and Wales, especially in Wales and Northern England where potatoes could be produced at altitude. Seed potato production did not develop to any extent in these areas largely because of the absence of good quality land.

Seed Potato Systems in Developed Countries: Canada, The Netherlands and Great Britain

Table 13. The responsibility for different activities and functions in the British seed potato system

Sectors	Agency
<u>Main production activities</u>	
+ breeding	SCRI, PBI + 1 private breeder
+ variety maintenance	DAFS(EC)
+ generation of initial disease-free material	DAFS(EC) + private agencies
+ initial multiplication	42 VT growers
+ multiplication	seed growers
<u>Support activities</u>	
+ research	MAFF, DAFS
+ extension	MAFF, Scottish colleges
+ credit facilities	nsp
+ breeding	SCRI, PBI + 1 breeder
+ market support	PMB
+ crop insurance	nsp
+ seed certification	DAFS & MAFF
+ disease eradication programs	DAFS & MAFF
+ plant health measures	DAFS & MAFF
+ aphid alert scheme	DAFS
+ disinfection service	DAFS & MAFF
+ market information	SSPDC & PMB
+ market development/promotion	SSPDC & PMB
+ variety evaluation	Recommended list: NIAB, Scottish Colleges, DANI, PMB. National list: DAFS, MAFF (NIAB), DANI, DUS trials: DAFS
<u>Market Organization</u>	
+ producer licensing	PMB
+ dealer licensing	PMB
+ processor negotiation	nsp
+ transport negotiation	nsp
+ terms of sale contract	nsp
+ sales restrictions	nsp
+ quality control	DAFS, SSPDC, PMB
<u>Policy</u>	
+ Source of material	DAFS
+ lab./plant health procedures	DAFS
+ allocation policy	DAFS
+ importation policy	DAFS/MAFF
+ disease eradication	DAFS/MAFF
SCRI	Scottish Crops Research Institute
PBI	Plant Breeding Institute
DAFS	Department of Agriculture and Fisheries for Scotland
DAFS(EC)	Agricultural Scientific Services, DAFS, East Craigs
MAFF	Ministry of Agriculture Fisheries and Food
PMB	Potato Marketing Board
SSPDC	Scottish Seed Potato Development Council
NIAB	National Institute for Agricultural Botany
DANI	Department of Agriculture for Northern Ireland
nsp	No specific provision

Under the terms of EC directives on seed potatoes, high grade seed can only be grown in the basic seed areas. The whole of Scotland and a small part of north-western England are designated as protected regions under EC seed potato regulations where only basic-category seed may be produced. This area is protected from the movement of potatoes into it from any source other than quarantine.

In the United Kingdom the production of seed potatoes for marketing is controlled by the Seed Potato Regulations 1984. These implement the requirements of the EC directives on seed potatoes. Under these regulations all seed potatoes sold must have been certified by the appropriate authority, in accordance with these basic regulations.

Under the British classification system all crops are automatically downgraded in each generation. There are two classes of virus tested stem cutting materials (VT1 & VT2) and three of Super Elite material (SE1, SE2 and SE3) and three of Elite. Two further classes are found: AA which can be grown in certain specified areas of England and Wales and CC which can be grown anywhere outside protected regions.

VTSC class material can only be produced by an officially approved grower, who is normally a member of the VTSC Growers Association. The initial stocks must be obtained from DAFS. The initial first- and second-year clones will be tested for viruses S and X (first year and second year, one leaflet per plant). The crop normally cannot be entered for classification until it is a third-year clone. Sampling for viruses (S, X, and any other important virus) is undertaken on all suspect plants in the third and fourth years. Land must not have had potatoes on it for seven previous years. Not less than two inspections are involved.

All classes of Super Elite can be produced by any grower in a protected region. Crops grown from VT will be classified as SE1 to denote that they are one year removed from VT class. Similarly SE2 and SE3 can be grown from SE1 and SE2 respectively.

Crops are not eligible for entry to certification without a certificate issued under the Potato Cyst Nematode Order which confirms that the land is apparently free of both *G. pallida* and *G. rostochiensis*. The land must also be free of wart disease, verticillium wilt of hops (not in

Scotland) and a number of other soil-borne pests and diseases. The broad requirements for the different classes are indicated in Table 14.

The major change in the certification scheme in recent years was the reduction of three years of entry for VTSC classification to two years and the former four years of foundation stock entry reduced to three years of Super Elite.

Certification is subject to a scale of charges by DAFS and MAFF and these are assessed to reflect full cost recovery for the service. In fact, charges have been held at 1982 levels up until 1986 as a result of economies in the running of the scheme.

An interesting recent development has been the launching of a quality control initiative by the SSPDC. This organization has been concerned at the extent to which the limited resources made available for official classification have constrained the overall image of the Scottish seed potato sector in the England and Wales market. Because of the structure of the sector and the ease of access to the large England and Wales market, it has not been easy to control quality. The occasional poor quality consignment and the resulting bad publicity has lowered the reputation of Scottish seed in this market and constrained the sector from capitalizing on its ability to produce a high quality product. The response by the SSPDC has been to propose the establishment of a private company which would run an extra quality-assurance check on all the seed potatoes of members. The aim is to establish an assurance of quality which would attract customers to suppliers who are members of the scheme. The company would be funded by participants of the scheme, who would benefit from the anticipated premium for this quality-controlled material as well as possible additional sales. The concept of the scheme was announced in September 1987 and is in the process of being launched.

Phytosanitary and Related Issues

The lead responsibility for phytosanitary issues in relation to potatoes is held by MAFF, particularly in international discussions on plant health matters. As noted above, DAFS plays the

Table 14. Seed potato classification standards, tolerances and requirements

Class	Origin of seed	Area	Purity and trueness to type (minimum standard)	Inspection	Maximum tolerance							Roguing	Separations (minimum)	Rotation and other requirements	
					Rogues (Groundkeepers variations)	Leafroll virus	Severe mosaic virus	Veinal necrosis virus	Mild mosaic virus	Blackleg*	Potato cyst eelworm**				
VTSC	From approved disease-free sources or VT1	0.1 ha	100%	All	None	1st. inspection 0.02% 2nd inspection None	None	None	None	None	None	None	No roguing before inspection then not more than 75/ha	All other seed on the farm must be at least SE1 Two drill separations from other early clones and VT stock	No potato crop in the 7 years previous. Pre-cropping soil test for potato cyst eelworm must have proved negative Burning down within 21 days of final inspection
Super Elite	Seed classified in 1986 as VTSC SE1 or SE2	Not less than 0.2 ha	99.95%	1st	0.05%	0.02% including not more than 0.01% of severe mosaic		None	0.05%	0.25%	None	1% maximum	At least 5 meters must be left clear at planting time between crops which are to be inspected and classified separately. Where crops are drilled in the same direction and side by side, a separation equal to 2 drill widths will suffice.	No potato crop in the five years 1982-1986 Pre-cropping soil test for potato cyst eelworm must have proved negative.	
				2nd or final	0.05%	0.01%	None	None	0.05%	0.25%	None	(No maximum)			
Elite	Seed classified in 1986 as VTSC SE, Elite or approved stock	As for Super Elite	99.95%	1st.	0.05%	0.1%			0.5%	0.5%	None	2% maximum	As for Super Elite	As for Super Elite	
				2nd or final	0.05%	0.1%			0.5%	0.5%	None	(No maximum)			
AA	As for Elite	As for Super Elite	99.9%	2nd or final	0.1%	0.25%			1%	1%	None	2% maximum prior to 1st. inspection	As for Super Elite	As for Super Elite	

* *Erwinia carotovora*.
 ** *G. (Heterodera) spp.*

key role in providing support for the seed potato sectors and discussion of all aspects of seed quality control.

In the United Kingdom there has been very strict supervision of any plant material coming into the country. The island status of the country has enabled the United Kingdom to stay free of a number of plant diseases and pests and consequently there is a long history of providing quarantine arrangements to protect this health status. In fact, on this argument, no seed potatoes could be imported into the United Kingdom prior to its full membership in the European Community. Upon gaining full membership the United Kingdom had to recognize the equivalence of certification schemes in certain Member States of the Community but it allows free movement of potatoes only into those parts of the United Kingdom which are not part of the Protected Region.

There has been a steady flow of new genotypes into the Scottish seed potato system, principally from Dutch private breeders. All of these new genotypes have had to go through the quarantine procedure before disease-free seed could be commissioned.

The most serious diseases affecting the United Kingdom crop are late blight, two main virus diseases, leaf roll and severe mosaic, and the tuber diseases black-leg, gangrene, and skin spot. Potato wart disease used to cause very severe problems but the identification of new varieties which are completely immune to this disease and the scheduling of infected land has virtually eradicated its economic importance. Late blight is still the worst single disease of the crop and while many of the modern varieties and control measures keep the extent of the disease in check there can still be substantial economic losses. The extent of these losses vary from year to year depending on climatic factors.

The Scottish crop tends to have a very good reputation for low incidence of virus disease, principally because of the relatively low occurrence of the principal aphid vectors. The Scottish environment, with its cold winters and often strong, prevailing, westerly winds and seed production areas at altitude, is ideal for low virus seed production. The introduction of novel methods to clean up virus disease has also contributed to this situation. The importance of climate was emphasized in the two drought

seasons of 1975 and 1976 when aphid build up resulted in more serious problems with virus, and it took several years for the health status of the crop to return to normal.

While the Scottish environment is generally good from the point of view of virus diseases there are a number of problems with tuber diseases, and in particular with black-leg. The factors contributing towards the incidence of tuber diseases are many, although it is widely recognized that the practice of leaving potatoes in the soil to bulk up to ensure that an adequate table-potato fraction is achieved, contributes to greater vulnerability of the crop to these diseases. Climatic conditions during the harvesting of the crop can be cool and damp and these can encourage tuber-disease breakdown. In fact, the extent to which seed imported from Scotland into England and Wales was subject to tuber diseases led to attempts to re-establish seed production in the main English ware-growing areas. Given that the Dutch seed potato-growing environment is little different from that of England and Wales, such a proposition could not be considered unreasonable. However, the English seed potato industry lacks the infrastructure of Scotland and The Netherlands, and consequently there has been a steady decline in the certified-seed area in England and Wales. In the mid-1970's this reached almost 3,000 ha but is currently at a level almost one half of this. We must conclude that the cost of maintaining the appropriate seed-health standards makes seed potato production unattractive in comparison with the alternative of purchasing seed from Scotland.

Potato Breeding

The structure of the UK potato-breeding sector has been changed dramatically by the privatization program of the Conservative government in power at the time of writing this report. Until 1987 commercial potato breeding was principally undertaken in two state funded breeding programs. One was based in Scotland at the Scottish Crops Research Institute (SCRI) and the other in Cambridge, England, at the Plant Breeding Institute (PBI). Another program is funded by the Department of

Agriculture for Northern Ireland. Both the GB-based institutes conducted a wide range of work concerned with breeding. This included the fundamental scientific research and the commercial breeding. In total some 400,000 seedlings have been grown each year and selection has been undertaken exclusively by the publicly funded institutes themselves.

A strong, private breeding sector existed during the late nineteenth and early twentieth centuries and many privately-bred varieties were in common use during the first sixty years of this century. However, because of lack of state support for private potato breeding, the post-Second-World-War period was characterized by the almost total eclipse of private potato breeding and the development of a very strong public sector. By the 1980's the only important potato breeding program outside the public sector belonged to Dunnett of Caithness (an ex-State breeder), but this was a new program and new genotypes from this source are only becoming available commercially in the late 1980's.

The domination of the public sector was challenged in 1985 when the government announced that it intended to privatize both the commercial breeding work of the Plant Breeding Institute (including the potato work) and the National Seed Development Organization (NSDO), the organization established to promote all states bred varieties. After a competitive tender and long negotiation, the offer of Unilever PLC was accepted.

The extent of the success of the State breeding institutes can be gauged by Table 15. This indicates the proportion of the total area grown in GB which is derived from different breeders. As can be seen the fruits of the post-Second-World-War investment in plant breeding began to be shown in the 1970's, with the replacement of traditional varieties such as King Edward and Majestic with, first, Pentland Crown and then, Maris Piper. However, during the 1970's there was also a growth in the relative importance of the Dutch-bred varieties, particularly Desiree and Wilja. During the 1980's, Dutch-bred varieties have assumed even greater importance and, in 1986, accounted for 40% of the total area, although this figure understates their position because there are

some Dutch varieties included in the "others" section of the table.

As noted earlier, the Dutch variety Desiree dominates the Scottish export sales and no State bred variety has a significant role to play. However, this is perhaps not unexpected as until recently the Charter of the Agricultural Research Council which governed the work of all the state-funded research institutes did not allow breeding for export markets. The charter specified that the institutes should work only for the benefit of British farmers. The Agricultural Research Council was supported by the NSDO who resisted such moves because of the implications for spreading their efforts and stretching their available resources. The issue of breeding for export became a major issue in the British system. The SCRI had to fight hard for a change in policy objectives, but the PBI was never permitted to take the same steps, although it did succeed in getting resources to screen existing varieties in some foreign markets. As a result of these constraints, selecting promising genotypes on the basis of their performance in export markets is a relatively recent procedure the fruits of which are not expected for several years.

Table 15. Relative share of varieties of total GB potato area

	1971 %	1981 %	1986 %	1971 %	1981 %	1986 %	
<u>GB State-bred</u>			<u>Dutch bred</u>				
Maris Peer	6	2	1	Desiree	4	14	11
Maris Bard	-	2	4	Record	5	9	11
P. Javelin	-	3	3	Others	-	9	18
Maris Piper	5	18	14	Sub-total	(9)	(32)	(40)
Kingston	-	-	1	<u>Irish Rep. bred</u>			
P. Crown	22	10	5	Cara	-	1	6
P. Dell	-	5	6	Others	29	10	9
P. Hawk	-	4	2	Total	100	100	100
P. Ivory	1	1	-	<u>Other UK bred</u>			
P. Squire	-	6	7	King Edward	15	6	2
Sub-total	(34)	(51)	(43)	Majestic	13	-	-

The UK now has a dual breeding system: the privately-owned breeding sector in which Caithness Potato Breeders operates like any Dutch private breeder (except that it does not have the same backing and support of the state as Dutch private breeders) and Unilever/PBI!

which has to develop its own strategy afresh given the purchased resources of PBI and NSDO. These two organizations will compete with the SCRI and with the various Dutch breeders' agents who both import Dutch seed and organize multiplication in Scotland.

New Variety Assessment

New varieties are assessed by their breeders and normally by years nine or ten, the selection procedure has identified clones which are suitable for submission to the National List trials. In this selection procedure the state breeders have been assisted by Agricultural Development and Advisory Service (ADAS), the extension service for England and Wales, and the NIAB. From year six onwards, there is also some screening in micro-climates around the Mediterranean.

For entry on the National List a variety must undergo trials for DUS and VCU. It must also undergo trials for DUS to qualify for plant breeders' rights. If the variety is successful in achieving National Listing, then it may go forward for the NIAB variety-evaluation trials. According to EC directives, for a variety to be sold and multiplied it must be on the National List, and to be on the list there is a requirement that it has to show improvement over existing varieties. However, such is the importance of environment in potato production, that it is very difficult to reject a variety unless it is very seriously deficient. Some say VCU is irrelevant to National Listing as the variety may have a role in different environments.

Decisions over National Listing are made by the National List Committee upon the recommendation of a VCU/DUS potato group. The decision is then reported to the UK Seed Executive. Upon ratification the decision is reported to the Plant Variety Rights Office for the granting of plant breeders' rights or entry on the National List.

The Recommended List trials are conducted by NIAB and based on VCU. These trials are conducted over three years at several sites in England and Wales. Common origin seed is used to assist comparisons. Decisions are made by the NIAB Trials Advisory

Committee and ratified by the Council of the NIAB. The Advisory Committee comprises an independent chairman and representatives of seed and table stock farmers, seed and table stock traders, ADAS advisers, the Scottish Colleges, processors, The British Association of Plant Breeders, MAFF, DAFS and DANI certification authorities, and the PMB. Variety recommendations fall into the following headings:

- P Provisional recommendation for a variety on which further trials are still in progress. Seed may not be available for commercial production
- G Recommended for general use
- S Recommended for special use
- O Becoming outclassed by other recommended varieties

The results are published and made widely available to the industry. Similar trials are conducted in Scotland by the Scottish Colleges, and, in contrast to the system used in The Netherlands there are no pre-trials and as a result there is some pressure on the NIAB to undertake all trials for all the varieties submitted.

Following acceptance on the recommended list the varieties undergo commercial assessment trials run by ADAS and by the PMB. The latter incorporate consumer acceptance surveys.

New Variety Development and Promotion

Despite the obvious success of the State breeding institutes in developing new varieties for potato production in Great Britain, some major problems and difficulties in developing new varieties have been experienced. Initially, all State-bred varieties were allowed to find their own level in the market with the assistance of farm-extension officers and the result of the State-funded variety assessment trials. Following the passing of Plant Variety Rights legislation in 1964 and the establishment of NSDO in 1967, there was a more concerted promotion of new varieties. This eventually involved the granting of limited periods of exclusive rights in a variety to private companies which could act as agents. A range of different licensing agreements were involved which

facilitated varying levels of risk-sharing over a number of years between NSDO and the agent.

In undertaking this work NSDO encountered much resistance and antagonism from a number of sectors of the potato industry. On the one hand there was a natural animosity towards an organization which was collecting a new charge (the royalties) on the industry. Also there was some bitterness over the control exerted by NSDO over the development of the area of new varieties as part of the program of commercial development. In both respects, NSDO was seen to be symbolic of a system with monopoly-controlled varieties which was very new to the seed-production sector, and which challenged some of the freedoms existing under the old order. In addition, the English (Cambridge) location did not endear NSDO to the Scottish seed industry, where English control of anything Scottish has numerous regrettable historical precedents. NSDO also came under attack from exporters because of its policy of granting exclusive export licenses to different countries rather than to specific varieties. This introduced rigidity into the commercial development of new varieties in the export market, especially when different organizations held the rights for the same variety.

Another area of conflict came in the area of licensing new varieties. Here NSDO was in a situation in which it could never win. The granting of a licensing arrangement which gave too much reward to an agent brought criticism from others in the industry, whereas an arrangement which gave too little incentive to agents was equally unacceptable because, as a result, little was accomplished. In granting a licence on the basis of tenders there were never any clear criteria for success, so that many who tendered felt aggrieved if they were unsuccessful. Equally, the need for a clearly fair system of allocation of licenses meant that some balance was required between English, Scottish, and Northern Irish agents.

NSDO found itself in an invidious position, uncertain precisely whom it was serving. There were several possible masters: the Treasury which would require extracting the maximum financial yield from royalty and sales; the seed industry of Scotland, which needs promising varieties to enhance its prospects; the table stock industry of England and Wales, which want

better, cheaper seed stock; or the plant breeding stations which provided the varieties (but received no additional direct revenue from seed royalties or sales). One result of this was that the NSDO found itself in a difficult political position which inevitably had an impact on its commercial strategy and success.

The conflicts are heightened by the transition to plant breeder rights. Before PBR, the State breeders saw themselves as having one object, the development of the potato sector as a policy objective. After PBR, the situation changes dramatically. PBR gave the opportunity for the Treasury to recoup some of the expense of public investment in plant breeding. These pressures become greater when there is substantial competition from breeders in the private sector and the need to operate commercially becomes paramount. Nowhere was this more apparent than in the approach to export-market developments where competition was tough and there was a need to have a very active presence in these markets and very coordinated commercial and industrial activities.

Release of Material Into the Certification System

Micropropagated plants are produced by DAFS. Seed tubers as first year clones are then issued to the 42 producers of high grade seed. There is a waiting list of farmers wishing to become VT growers but the number is held at a level which, in the view of DAFS, will present a sound base for the industry. Traditionally, clones are issued on request although, as indicated above, under the arrangements of the VT Growers Ltd. co-operative there is an element of consultation and collaboration in order to attempt to plan the movement of potatoes into the seed system. For many of the varieties which are subject to plant breeders' rights, seed is commissioned by the breeder or his agent according to his market requirements. There are a number of varieties which have been bred by the State breeding institutes which are subject to plant breeders' rights but for which no planned commissioning of initial seed stocks is practiced. To all intents and purposes these varieties come into the seed multiplication system in the same manner as

free varieties except that royalty payments must be made when they are grown for seed.

The product of the initial multiplication is then sold on to other seed growers for further bulking-up of the seed.

There is new investment taking place in the field of micropropagation which promise to bring substantial changes to the seed sector. Two companies, Twygen and Nickersons, are investing in large micropropagation units, with the Nickerson laboratory promising to produce material at prices which will challenge multiplication at the highest levels of the multiplication chain. At the time of writing this report, these investment plans had just been announced and insufficient time was available to fully assess the implications.

Market Support and Regulation

The seed potato sector can take advantage of the Potato Marketing Scheme. While the scheme has provided some support for the table stock fraction of the seed crop its support represents a relatively small element of assistance for the seed potato grower. As a result discussions on the possibility of supplementing the existing arrangements with special provisions for seed potatoes are in progress. The possibility of the industry supporting its own scheme in a similar manner to that of STOPA in The Netherlands or of an extension to the PMB scheme to apply specifically to seed potatoes is being considered. The implication of the former in terms of cost for individual growers is considerable.

Promotion

There are two types of promotion required in a seed potato system. The first is the promotion of the source of seed and the second is the promotion of varieties.

In the first area the work is undertaken by the PMB and SSPDC. The PMB's involvement has been restricted to exports, although the export field is now largely covered by the work of the SSPDC which has the main responsibility to promote the Scottish seed potato industry. SSPDC has focused its attention on promoting

Scottish potatoes in the main markets in which it has a presence. This work includes an important element of variety promotion, as many varieties available are not subject to monopoly control and, therefore, there are no agents with the incentive to promote them. It also organizes domestic missions and courses as support to the promotion of Scottish seed potatoes. It also focuses attention on the all-important England and Wales market which takes the vast bulk of Scottish seed potato volume.

Until 1987, NSDO also participated in promotion through its interest in new variety development. The sale of NSDO means that the rights for the varieties which it was marketing also pass into the hands of Unilever. In future the SCRI, the only remaining plant breeding institute in Great Britain, will have to devise its own arrangements for promoting new varieties. This will probably mean establishing agencies with private companies.

In the England and Wales market, by far the most important factor is receiving "recommended variety" status as a result of the NIAB variety evaluation trials. This means that on the basis of trials conducted on sites throughout the UK the variety has performed with consistency, and it also has good cooking characteristics. A "General" recommendation virtually assures success. In overseas markets it is important to provide an incentive for traders to pursue those markets. The Dutch system has built-in incentives, as breeders or their agents will benefit from sales. Harnessing these incentives has proved difficult in the British system, largely on account of the political problems encountered by NSDO, as illustrated above.

Other Support Activities

There is a wide range of support activities provided through various government agencies. However, in recent years, the tendency has been for these to be charged for, as cost recovery and, in some cases, private sector policies are implemented. There are no special schemes for credit and insurance although like other farm sectors, the seed potato industry can take advantage of national and EC capital investment schemes.

12. Comparison and Conclusions

The previous sections have examined in some detail the nature of the seed potato systems in three developed countries. The basic differences are summarized in Table 16. Also, presented in Appendix 5 are the results of a survey conducted by the Economic Commission for Europe on seed certification and classification systems of member countries. The results of this survey are presented without modification or discussion, although it will be apparent that adequate comparisons between countries need far more detail than is provided by this table. The table has to be read in conjunction with the relevant chapters of this report.

The System Character

What are the strengths and weaknesses of the three systems? These are considered in very broad institutional terms in the following subsections.

Canada

The Canadian seed potato industry can be characterized by a significant federal commitment to the seed potato industry backed by provincial seed industries of very substantial differences in character. At the federal level, attempts have been made to lay down the basic framework of national support so that the autonomous provincial seed industries can develop to the best of their ability. The main strands of federal support cover general phytosanitary controls, laying down of plant health standards, and the imposition of seeds certification standards backed by inspection. Federal funding is generous and covers a wide range of measures to assist the provinces, with some of this assistance being justified on the basis of regional development in some of the most disadvantaged provinces of Canada.

The two major seed-producing provinces differ quite considerably in terms of character.

In Prince Edward Island a producers' organization has been established and granted considerable powers to organize and regulate the seed potato industry. In this respect it has support in a number of key areas from both the provincial and federal governments, although it is the Potato Marketing Board which is principally concerned with dictating the direction which the seed potato industry takes.

Despite a number of compromises, this method of organization has enabled the PEI seed potato industry to make substantial strides over recent years. Despite being a producer-controlled organization the Board has allowed market forces to bring about substantial adjustment in the production sector so that the degree of concentration of ownership and specialization has increased considerably over recent years. The price of allowing changes in the structure of production to take place has been unpopularity amongst a section of the seed-production sector. A recent plebiscite almost produced a majority against continuation of the PMB system. The narrow victory of the PMB in the plebiscite has prompted a major review of the operation of the potato industry, but unfortunately the results of this review were not available at the time of this study.

As a gesture towards producer resistance to some of the structural changes which have been taking place, there are a number of characteristics of the system which considerably modify competitive forces within the potato industry of PEI. Notably there are restrictions on the terms at which seed may be sold between producers on PEI.

The most interesting characteristic of the PEI potato market system is the very high percentage of the total area entered for seed certification. This has one major economic advantage in so far as it allows the potato growers of PEI to grade the whole crop according to market requirements. There are, therefore, certain advantages of economies of scale. Linked to this is the provision that all potato

farmers must grow some seed (this requirement was recently upgraded to insist that at least 10% of the area is Foundation seed). The reason for this policy is to subject all potato-production units to inspection and thus allow the industry to more easily monitor possible disease problems. Certainly, these two features must mean that, overall, the plant-health status of the PEI crop is much higher than in many other parts of the world, but it does not necessarily mean that the plant-health status of the seed crop, that part of the crop for which it is really important, is necessarily any better.

It is argued in New Brunswick that it is far better to have specialist seed potato growers who can provide the necessary specialized professional skills required for seed production. There are certainly many potato growers on PEI who have little interest at all in supplying the seed potato market, as they have processing contracts, or have developed table-market outlets in Canada or in the United States. However, the PEI argument would be that over the years the PEI grower has developed very high standards for the potato crop and would work to apply those standards for the whole of the crop. Empirical evaluation of certification results would support the PEI argument. Federal government certification results indicate that the percentage of both fields and hectares passing certification is higher in PEI than in New Brunswick and suggests that, at the general level, the PEI potato industry is able to maintain the high standards necessary for seed production, even though a large part of the output does not go for seed utilization.

It is generally accepted that the New Brunswick industry is subject to greater disease pressure because of the greater prevalence of aphids in the growing period. This problem has increased in recent years with the planting of a wider area of Russet Burbank and Shepody which are both susceptible to virus. However, this does not explain the differences between the two provinces because PEI has a relatively greater area in Russet Burbank than New Brunswick.

The question also arises whether post-harvest procedures in PEI are likely to result in greater difficulties than arise with other systems. There is certainly the potential for more cross-contamination of tubers as a result of the wider

use of central grading systems in order to grade the crop according to market requirements. There is no way of checking whether or not this has a detrimental effect on the quality of PEI seed potatoes because there is no formal collection of representative data on post-sales quality.

Certainly, if one examines the development of market share, it is PEI which has shown the greatest growth in recent years, and this growth can only be achieved if the sector is providing the kind of potatoes which are required in the market place. Whether PEI is increasing its share of the seed potato market is difficult to establish from the statistics. It is clear that they have considerably increased their market share of the off-shore export market and now account for virtually all of the Canadian seed potato industry's off-shore sales with the exception of those to Cuba. There are several possible explanations for this. On the one hand PEI industry does not have to face such large transport costs to get seed to ports. Transport from the major New Brunswick areas to loading points add as much as \$ 1.50 per ton to the New Brunswick export price. However, this is probably a small factor when compared with the advantages which PEI has in being an island where the bulk of its product is exported, and where the potential to orient the industry towards meeting export requirements is enhanced by its island status and by the potential for imposing greater discipline among potential exporters.

In sharp contrast, New Brunswick producers have the northeast United States market on their doorstep, and the numbers of routes which can be chosen to service this market and other Canadian markets demand more in terms of export organization.

In Canada we came across the only formal attempt to assess the cost-benefit ratio of a seed potato certification program. An evaluation of Plant Health and Input Assurance program expenditure of Agriculture Canada by the Audit and Evaluation Branch attempted to quantify the benefits. This evaluation covered several aspects of the seed potato program. The methodology involved personal interviews and client surveys (e.g. farmer-users). The main indication of the value of benefit of the certification services came from the farm survey

portion of the study where it was concluded that farmers were prepared to pay 20% more for certified seed. However, as it is often difficult to identify price premium for seed potatoes in Canada and, as many of the table potatoes used are of seed standard, the basis of this methodology must be questioned. The total benefits accruing at the farm level and from

exports were estimated at \$85 m over the period 1981-1985 and yielded a benefit/cost ratio of 3:1. The report (Agriculture Canada, 1987) concluded that the program operated satisfactorily with recommendations for some administrative changes in laboratory services and greater cost recovery.

Table 16. Characteristics of the different seed potato systems

	Canada	The Netherlands	Great Britain
Total potato production, 1986	2.8 tons	7.2 tons	6.1 tons
Total seed potato production, 1985	871,000 tons	1,038,000 tons (1984)	779,000 tons
Total seed potato sales on domestic market, 1985	223,000 tons	266,000 tons (1984)	341,000 tons
Total seed potato exports, 1985	94,000 tons	541,000 tons	66,000 tons
Development of the seed industry over the last 15 years (early 1970's to mid 1980's)	Certified seed area has increased slightly from 27,000 to 35,000 ha. Output of seed has increased from about 550,000 tons to about 850,000 tons although only about one quarter of this is sold as seed. Exports have remained static at around 100,000 tons	Certified seed potato area has increased from an average of about 19,000 to about 33,000 ha. Output has increased from 400,000 tons to about 1 million tons. Exports have increased from 300,000 tons to almost 600,000 tons	Certified seed area declined from roughly 22,000 to about 19,000 ha in the 1980's. Seed sales to England and Wales static at between 250,000 and 300,000 tons, exports increased from about 15,000 to between 50,000 to 80,000 tons
Political importance of the seed potato industry	Nationally only represents 1.5% of farm receipts, but provincially very important. As these provinces are less well-off so the importance of potatoes is elevated	Potatoes represent 4 to 5% of sector production value. Only 1 to 2% of total agric. export value, but the most prominent arable export crop and exports very important to the economy as a whole	Potatoes are 5% of the farm sales. However, they are important to the farm economies of northern Ireland and Scotland. For this reason they attain relatively high political importance
Climate and natural resources	Short growing season (120 days) with rarely any serious moisture deficit. NB more stony soils, PEI some soil compaction problems but generally good, stone-free conditions. In main seed production areas, no altitude and reliance on wind to maintain low aphid populations. Very long, harsh winters.	160 day growing season. Fertile, stone-free soils, with usually adequate supply of moisture. No altitude and reliance on prevailing westerly wind to maintain low aphid population.	170 day growing season. Altitude and strong prevailing westerly winds during growing season to keep aphid levels down. Variable, often stony soils. Danger of cool, wet harvest conditions.
Disease and pest problems of major economic significance	Late blight, virus problems, primarily. Occasional occurrence of BRR	Late blight, PCN, tuber diseases (more recently blackleg), virus diseases in general	Late blight, tuber diseases (especially blackleg), viruses and PCN
Disease's advantages	Absence of potato wart disease, PCN (<i>G. rostochiensis</i> and <i>pallida</i>), PMTV, gangrene	Absence of BRR	Absence of BRR
Structures	Average size of potato holding 17 ha Seed production concentrated in PEI and in parts of NB Merchant trade not very concentrated	Average size of potato holding 7 ha Seed production concentrated in the NW Netherlands Merchant trade fairly concentrated	Average size of potato holding Scotland (12 ha), England and Wales (8 ha) Seed production concentrated in Scotland Merchant trade not very concentrated

Seed Potato Systems in Developed Countries: Canada, The Netherlands and Great Britain

Table 16 (cont.)

	Canada	The Netherlands	Great Britain
Organization	Federal responsibility for certification and general phytosanitary issues but strong provincial participation in disease eradication measures. Federal provision of research, breeding, market regulation, credit, crop insurance and more general areas of financial support. Certain provincial autonomy in the organization of multiplication and promotion. Federal and provincial involvement in export promotion. Differences in market philosophy. In NB virtually free market environment operates. In PEI market conditions strongly influenced by the PMB.	Certification is organized interprofessionally with supervision by the State. Interprofessional administration of market support and promotion. A free and unregulated market	Phytosanitary issues and certification a government department responsibility. Market support for table potatoes undertaken by producers under firm government supervision. Interprofessional involvement in promotion
Market	Domestic demand is for a large seed tuber which can be cut. Export demand is for a much smaller size-graded product The varieties grown reflect the need for a good processing potato for french fries and also a large-sized table-stock potato	Seed demand is principally in the smaller size grades The variety Bintje dominates home consumption but a wide range of varieties are grown to meet the needs in export markets with widely differing environmental circumstances	Seed demand is principally in the smaller size grades Varieties tend to be those consumed on the GB market and few specialist export varieties are grown. The varieties reflect the processing needs and red- and white-skinned-table demand
Market infrastructure	A large part of the seed output is sold by the producers themselves. These sell to traders in the importing states of the US	All seed sales are arranged by the seed-merchant sector. This sector is dominated by a small number of very large co-ops and private companies who are both breeders in their own right and also serve as agents for the other breeders Compared with producers in UK and Canada producers generally have relatively small quantities under their control	A specialized seed potato merchandising sector has emerged with a strong tradition of producer involvement. Sales may involve distributors or agents in the major market of England and Wales
Industry charges	Producers pay a nominal amount for certification and levies to either the NBPA or the PMB. These amount to only 1% of key variable costs	Levies payable for all inspection and testing and for market support and promotion. These represent almost 25% of key variable costs	A certification charge plus levies to the PMB represent about 10% of key variable costs
Nature of system	In PEI, seed and table potato is combined with the final use of the potato not predetermined. However, all potatoes produced are certified. In New Brunswick seed potatoes are principally grown for seed utilization	Seed potato production is conducted as a separate and specific activity with all seed potato growers planting the crop for seed sale. Thus the crop is managed exclusively to produce a seed crop. Top killing to control virus diseases also produces seed sizes which are popular on export markets	Seed production is largely specialized although the larger potatoes which fall outside the seed grades are sold for human consumption. Thus growers are also thinking of the revenue from the "top" when producing their crop. This produces some conflicts as the longer the crop is left in the ground to bulk up for "tops," the greater risk of tuber diseases

Table 16 (cont.)

	Canada	The Netherlands	Great Britain
	No private breeding is undertaken and currently all varieties produced are unprotected. Initial multiplications are undertaken by Elite seed farm and then high-grade seed growers. Then sale to low-grade seed growers. Some private varieties being introduced, and initially the PMB and the NBPA hold the contracts for maintaining these varieties for the purposes of commercial assessment	A major part of output represented by monopoly-owned varieties. Breeders through their agents decide how much initial disease-free material to commission from the NAK. For free varieties high-grade seed growers maintain their own seed plots and commission disease-free material from NAK according to needs.	Very little private breeding but some State breeding currently being privatized. Several protected varieties under State and foreign private ownership being multiplied. Free varieties are maintained by government departments and initiation of multiplication is on request of the high-grade seed growers. Disease-free material of protected varieties (largely under foreign ownership) are commissioned from DAFS and may be further multiplied by private labs by breeders agent and grown on contract although contract growing may only extend for a part of the seed multiplication chain before open market sale to other seed growers. Some protected State-bred varieties are subject to controlled release by an agent of the State breeders, others are freely available
Initiation of multiplication	All varieties are maintained by the NBDA and PMB seed farms. In NB all initial multiplications are by micro-propagation from field selected disease-free clones with a complete flush-through system. In PEI by micropropagation and clonal selection with the first two or three generations under the control of the PMB Elite farm. Also some multiplication from seed plots of growers	Initial material is derived from high grade growers' or breeders parental seed plots. The material is entered for certification and subject to appropriate testing by NAK. Twenty-five per cent of initiations are commissioned through a private (foundation) micropropagation lab. Competition from other labs is just evident. The system is not flush-through	Initial material commissioned by high grade seed growers or breeders agents from DAFS using micropropagation. Then a flush through system operates
PBR legislation	None, but been proposed since 1973 and currently on governments legislative program	Some form of formal breeding incentives since 1944. PBR since 1967	PBR legislation introduced in 1965
Market support	None specific to seed potatoes but payments are made to the potato industry on an ad hoc basis in very bad years. A price insurance covers the farmer against crop loss which can be a real risk in Canadian circumstances.	The STOPA scheme offers guaranteed prices to the seed growers. Financed by levies on the industry	No specific scheme for seed potatoes, although the PMB operates a scheme principally for table potato growers which can be used by seed growers. This is funded by producer levies and government subsidies

Clearly where the benefit is calculated to be high and that benefit is deduced to derive from the additional price customers will pay, the need for government subsidy of the service is to be questioned. The fact that full-cost recovery does not exist is particularly explained by the important requirement for general economic support to the Maritime Provinces through the seed potato industry, and partly by doubts over the extent to which the seed premium exists. It is clear that potato producers in New Brunswick are highly dependent on the potato crop and

face sufficient, very real economic problems without having extra charges imposed.

The Netherlands

On all accounts it is the Dutch industry which has been the most successful in terms of its ability to expand its market share. The success of the Dutch seed potato industry in developing markets throughout the world is well known (Appendix 1, Figure 1). The extent to which this

progress has been maintained and the dominance which the Dutch industry exhibit in the world, seed potato market suggests that their seed potato system has some major strengths. On the basis of the physical attributes of the country for seed potato production, The Netherlands is not as well placed as many other countries. While it has fertile soils, a constant availability of water supplies, and fairly stone-free soils, it can be subject to quite high levels of aphid infestation with the consequent problems of virus diseases. Despite this adverse factor, the Dutch have imposed a seed potato system which imposes the necessary discipline to reduce the severity of this problem. The imposition of obligatory top-kill dates on the basis of aphid build-up help to overcome this problem. Indeed, the combination of these measures and successive hard winters which have reduced over-wintering aphid populations has reduced the incidence of the problem drastically.

The organization of the seed certification system is in the hands of the industry itself and the maintenance of adequate standards and industry discipline depend to a very large extent on the general cooperation of the members of the different professions involved. In particular, they need to be aware of the need to maintain certification standards and procedures which will ensure that the health status of the product is suitable for the longer term development of the market. The sanction for the industry if it fails to do this is loss of market share because of customers' lack of satisfaction with the product. This assumption of responsibility on the part of the industry as a whole is a common theme in the organization of Dutch agriculture. Many of the central bodies take responsibility for functions which in other countries would be conducted by the government. As such the seed potato sector is used to subjecting itself to self-imposed disciplines and this has become a part of the way of life of the sector.

The Netherlands is a relatively small country and its potato production is concentrated in certain areas. This encourages a sense of unity within the industry which is reflected in the institutional arrangements. The institutions with responsibilities for various parts of the seed potato sector are characterized by interlocking membership so that the directors of one institute or organization will also be members of others.

This produces a neat, coherent institutional framework which avoids duplication. Despite this, there is a little institutional untidiness and one could question the boundaries of responsibility between NAK and PD for certain aspects of rotation control and nematode testing, and between SVP and ITAL in breeding work.

But perhaps the most important feature which serves to strengthen the Dutch seed potato system is the extent to which the sector is very clearly market orientated. It is subject to relatively little government regulation and this affects the availability or pricing of material entering the multiplication system. The basis of the industry is the selling of privately-owned varieties and, as a result, essential decisions in relation to how much to produce and how and where to market it are taken by private individuals who each can assume risks which are commensurate with their resources. The decisions depend entirely upon their assessment of the situation. In addition, this market orientation is reinforced by the presence of the hobby breeders/selectors. The hobby breeders represent an important resource for the Dutch industry as they are prepared to screen a very large number of seedlings at very little economic cost. As the chances of success in potato breeding are increased by the numbers of seedlings screened, they represent a critical feature of the system, and will continue to do so even with the introduction of novel techniques to produce new genotypes.

The private sector is supported by a range of institutions which are funded by the industry and which can conduct various activities for the common good. For example, these institutions:

- provide information on markets which will assist the decisions on what varieties to breed and how much seed to multiply;
- provide essential promotional support for the free varieties and for The Netherlands as a source of seed where this is not provided by the industry itself;
- will help support the market price and reduce production and marketing risks where it is essential that these risks be taken for the benefit of the entire industry;
- conduct the applied breeding work which is necessary to ensure that the industry has an adequate supply of the necessary parental

material from which new varieties can be produced;

- provide specialists to assist with market development activities and with special customer servicing requirements; and
- undertake the pre-trials necessary to select promising varieties before official testing.

Finally, the industry receives the support of the state in critical areas. For example:

- much of the fundamental research would not be undertaken if it was not for government finance;
- the government pays for the variety testing service.

Also, in the area of plant health control the Ministry of Agriculture has imposed an extra level of control for export consignments. This is of importance when selling to overseas markets, as many issues in relation to plant health are discussed and negotiated nationally through government departments. There is also some help for market development through the activities of the government departments responsible for economic affairs, and for the economic development of Third World countries by virtue of the contribution of potato exports to the balance of payments.

The ingredients of this success would appear to be the dynamic nature of the industry as a result of the combination of competition and industry coordination and cooperation. At the level of the individual farm or merchant there is substantial competition but there is also substantial cooperation to fund activities for the common good. As discussed in the introduction, the competitive position of the three sectors comes down to price, service, and quality. It is at the level of service that the Dutch system scores. Because the sector has relied on exports, and because the exports are undertaken by private organizations, the communication of the export requirements tends to be good. Exporters recognize that if they do not supply their goods to their customers then they will not get future orders. Thus, discipline is imposed at the individual firm level. At the sector level, the institutional framework is sufficiently mature and developed to accommodate total industry participation which allows all to see the requirements in terms of conquering world markets. Thus, producers can see the difficulties of exporters and can appreciate the skills

required to overcome these problems. The feedback of information from market to all the players in the industry is direct and effective and represents a key strength.

The question arises whether this form of organization leads to compromises in the procedures adopted. At first sight, the success of the Dutch in export markets suggests that the system works remarkably well. However, there exist a number of areas of concern. First, there is the relatively slow transition to micro-propagation with its acknowledged advantages in producing seed of disease-free status (but still with certain question-marks in terms of effect on trueness to type). Second, there is the potentially long multiplication chain. Thus, it is feasible (though uncommon) that an E grade could be nine generations from the original disease-tested material. Third, there is the continuation of the system in which growers are able to maintain free varieties themselves. The organization of the certification scheme by the industry itself ensures a pragmatic approach, but the checks in the system are such that this pragmatism does not impinge on commercial development. Thus, if the system should not be working well and customers have problems with quality, then the representatives of the marketing agents will exert pressure for a change in procedures.

The system is self-correcting because any developments which threaten the future position of the system should result in adjustment. However, if any of these features became a serious constraint on sales because they jeopardized the quality image of Dutch seed, then changes would be made. Because of the interprofessional involvement, the consideration of changes would take into account all who participate in the system. Thus, under the Dutch system, the farmers and traders have a very direct and equal contribution to the debate on the level of standards. In the UK and Canadian system, these standards would involve consultation but are unlikely to be as responsive to the needs of all as the Dutch system.

A more cynical view would suggest that the heavy interprofessional involvement allows potential problems to be covered up. However, in many ways, the Dutch seed system is very open, with contact encouraged between the industry, NAK, and its customers in overseas

countries. It is difficult to see how any major deficiencies exist in comparison to competitors, when trade has expanded so consistently (Appendix 1, Figure 1).

The nature of the institutional framework of the Dutch seed potato sector is currently undergoing a period of slight adjustment. In particular, there are changes in the area of the role of the State. While there has been substantial industry participation in the organization of the various institutions, as noted above, there have also been some important areas of government assistance. Increasingly, under the pressure of the need to reduce government expenditure, the government is withdrawing from these areas and relying on the industry to fund more of the support services itself. This particularly applies to the areas of variety testing and plant breeding, where the industry will be asked to pay a much higher contribution.

In the plant breeding area this has meant that policy changes will be introduced. Inevitably, the industry will demand more say over the direction of policy as it pays for more of the services. Thus, in plant-breeding, the breeders' representatives have requested more parental material to be released and the suspension of the issuing of seeds and first-year clones directly to hobby breeders. This has strengthened the hand of the breeding companies and reduced the alternatives of the hobby selectors. There is some danger that the new moves could prejudice the good will of the selectors, although, generally within the industry, there is a very good appreciation of their contribution and a sensitivity to the need for maintaining their interest and contribution.

The only anomaly is in the area of the certification service itself where the government is currently trying to both reduce its subsidy but also to maintain its share of the funding. This means that the industry will also have to reduce its funding further shrinking the budget of the service. The origination of this subsidy was the perception that other competing certification services were also subsidized. However, this is not so clearly the case now and, as a result, the Dutch industry gets substantial advantage from this subsidy despite the high contribution from farmers.

Despite these changes the fundamental strength of the Dutch seed potato sector remains intact. The sector continues to have a:

- strong, motivated breeding sector with essential support from research, testing, promotional and market-support institutions;
- strong market orientation with a very direct feedback of market developments and information to the breeders;
- very responsive sector which operates without regulation except where it is absolutely necessary.

The Dutch system also copes very well with risk. There are many who are prepared to take on the risks which are necessary to develop new products or new markets. However, in certain areas it is not necessary to bear the full risks because of industry or government participation in the funding. The balance is critical. If the industry is too sheltered from risk then it will become complacent; if it is too exposed to risk, then many essential initiatives are unlikely to be taken. In the UK system, many have been unwilling to assume risks because of the lack of incentive. The State ownership of varieties and the agency arrangements negotiated have not been sufficient to initiate the necessary intensive activity in overseas markets to get varieties on National Lists and to develop their sales. In the Canadian system similar problems arise, although here they are made even more acute by the absence of Plant Breeders' Rights legislation. No Canadian exporter is going to spend money promoting a new variety unless he has exclusive rights to that variety.

Great Britain

The Scottish environment is excellent for seed potato production as far as virus is concerned, but there are problems with bacterial diseases, especially blackleg. This problem is made worse in cool, damp years. In order to combat this disease there has been extensive research initiated and farmers have been given advice on husbandry practices which reduce the risk of infection. The procedures initiated over the years by DAFS for cleaning-up the general health of clones entered into the multiplication

system have undoubtedly made a great contribution to the economic position of the industry and have capitalized on its natural advantages. The fairly rapid introduction of new propagation methods for producing disease-free stocks, such as micropropagation, remains a strong feature. But, perhaps the major challenge to the Scottish system lies not in its natural conditions, as these are very good, but more in the institutional framework of the sector and its structure.

The feature of the British seed potato industry which has set it apart from the Dutch is the organization of its breeding sector. Historically, in the British system it has been the State-funded breeding which has been supported and not private breeding. In the Dutch system both have received support in different ways. This has been one of the most important factors leading to the very different character of the two systems. The British seed potato sector faces a fresh challenge as it adapts to the fundamental and far reaching changes introduced into the breeding sector. The State breeding stations have played a very important part in the past as they have produced a wide range of new genotypes which have displaced traditional British varieties. The privatization of one breeding station and the commercial demands being placed on another, demand a re-orientation of all those who were working in those institutions. However, it is difficult to create an effective private breeding sector overnight.

There are several prerequisites for a successful potato-breeding system which are evident in the Dutch system. First, there is the need for a wide range of specialist back-up services, second, there is the need for a good link between the market and the breeding sector, third, there is the need to intensively screen as much material as possible to improve the chances of success, fourth, the right type of screening provision is required. In respect to the latter, experience appears to be vital and the screening must be undertaken in appropriate environments. With many Dutch varieties being appraised in British conditions the competition has become much tougher.

The system where state breeding dominated had a number of defects in comparison with the Dutch system. It was less market orientated simply because there was no direct

contact between merchants who had responsibility for selling new varieties and the breeders who had the task of producing them. There was also a lower propensity for taking on risks, particularly when government spending was subject to intense scrutiny. It was also characterized by comparatively narrow breeding objectives in comparison with the Dutch system as there were only two institutes in Great Britain. In the Dutch system each breeder has a different target and this means that the possibility of success is increased. A good example was the argument for the PBI to give up early potato breeding on the basis of impending Spanish entry into the European Community and the belief that early varieties could not be grown in the UK. When one of the two institutes pulled out, it left a vacuum and it remains to be seen whether Unilever will attempt to fill it.

There are also severe difficulties when identifying how you commercialize state-bred varieties. The account in the UK section of the difficulties of NSDO emphasizes some of the problems of commercializing public assets. There are two possible approaches: to commercialize the variety through a State funded agency; or, to ask another organization to do it on an agency arrangement. There are many precedents for both of these being done successfully, so why did NSDO encounter so many difficulties? The major difficulty is that State assets which are an input to an agriculture sector such as seed potatoes attract historical non-commercial commitments which are difficult to dislodge. In commercializing new varieties in a competitive environment, some hard commercial decisions have to be made and these are not easily implemented by an organization which finds itself subject to various political pressures.

The publicly-funded breeder sector will have to devise new variety development strategies which can compete with the private sector. This will demand great flexibility in terms of matching market requirement to breeding effort. In the past this has proved successful at home where there is a sound commercial understanding of variety requirements. But the challenge in breeding for foreign markets is much greater as fairly detailed knowledge of these markets is required. The other major

challenge is to identify the relationship with an agent and provide the agent with sufficient incentive to develop the market. This will demand a tough and commercial approach if the varieties are to succeed in the England and Wales market and overseas.

The problems faced by NSDO highlight the advantages of the Dutch approach to potato breeding. Under the Dutch approach there is a very direct link between all parts of the breeding activity and the market. This link comes through prudent interprofessional involvement in the direction of much of fundamental and applied breeding work conducted by State-funded institutions and by the very direct tie-in of commercial marketing agents with the commercial breeding activity. If, as is the case of The Netherlands, the State is not permitted to produce commercial varieties then many of these problems do not emerge. There is no product to commercialize and therefore the procedures to commercialize directly or through an agency are not required. Then the role of the State institution is simply to provide the material needed by the potato sector for breeding or selection. In this way the State and private sectors work together with a single purpose, each calling on the strength of the other. In the case of the State sector its strength is in the mobilizing of funds and resources for basic research and the strength of the private sector is in the flexibility and market orientation which arises from the incentive of private companies to succeed. As long as the State considers that it gets its return from the creation of wealth by the breeders, such a system can be sustained. It could be argued that there is a substantial state subsidy in the Dutch system as the seed potato industry does not pay the full economic worth of the material that it uses. However, as the material passed onto the breeders has no commercial value without the unique input of the skills of the breeder, and as the breeder may add other genetic resources, this argument is difficult to quantify and sustain.

The Scottish system includes some provisions for reducing the substantial risks in seed potato production and marketing. However, the market regulation activities apply through the general scheme for potatoes and not through a specific seed potato scheme. It appears that there is some movement to achieve this through

a number of initiatives, although some of the options being considered depend on State funding. In the longer run, it is expected that any scheme is principally industry-funded. The principal advantage of such funding is that it will avoid distorting the market and hence increase longer term efficiency. However, a major consideration is the support arrangements for the table crop. In Scotland most seed growers also sell table stock and therefore their overall risk vulnerability is dependent on the cover for both fractions of their crop.

There has also been a history of failures in the merchandising sector and these have served to emphasize the nature of the investment risks when trading potatoes, particularly in the export market. These risks will always be present and will need to be taken by someone if market development in export markets is to be continued. The risks are reduced slightly through industry or government-supported promotion and by appropriate credit schemes. The Dutch have become so specialized in the area of exports that their export servicing is much more likely to be tuned to the needs of this sector than is the case in Scotland.

A major problem of the Scottish seed potato sector is the high dependence on the variety Desiree for exports. As this variety is no longer protected by plant breeders' rights legislation in other countries, competition will increase. The export breeding effort will be limited because of scale and resources. It is difficult to mobilize effort to attack the export market without varieties or the incentive to develop those varieties. In comparison with the situation in The Netherlands, relatively little effort has been devoted to breeding for export markets.

Traditionally, seed potato marketing has been difficult because of the absence of monopoly-controlled varieties and the lack of incentive to promote varieties. The general promotion of seed use had been left to the advisory services and it was not until the SSPDC was established that a systematic effort to increase certified-seed use from Scotland could be developed. Before the establishment of the SSPDC the task was left to the various trade associations acting independently or together. However, even today promotion is also very limited, largely because of the lack of political

commitment to support a major promotional effort. There is no formal joint promotion of United Kingdom seed with the Northern Irish seed industry, largely because of the rivalries between the two UK seed sectors. Because of this there is often some duplication of activity.

In the Scottish sector there are some severe difficulties with imposing adequate discipline. There are several factors which contribute here. First, the England and Wales seed potato market is easily accessible from Scotland. It is a large market and Scottish seed is cheaper than the seed of the competitors. It is fairly easy to sell into the market of England and Wales through a wide range of trade channels. Such is the nature of this trade network that the potatoes can change hands several times. This ease of access encourages many potential suppliers and frustrates attempts at coordinated marketing. In particular, this makes it difficult to police the quality of all supplies sent to the United Kingdom and identify those who sidestep standards. Second, the industry structure is fragmented which means that there are many potential suppliers of the England and Wales market.

The certification service is neither full-time nor specialized, and it is tempting to suggest that if it were a better service could be obtained; however, given the area over which seed potatoes are grown, the cost of maintaining such a service would be very high. In addition, currently, the certification service is very clearly seen as a government imposition rather than an essential service in order to develop markets. This is in contrast to the situation in The Netherlands, but similar to that of Canada. The move of the SSPDC to initiate its own voluntary, quality-control scheme is some evidence of concern over the level of resources being used for certification and the nature of the service provided. The initiative should, if it is successful, prompt greater industry involvement in the process to the advantage of all concerned. The lack of a sense of industry responsibility results from many years of selling into a protected market and from the structure of the industry. The introduction of competition into this market and the need to develop exports has underlined the need for everyone to be aware of their responsibilities in maintaining reputations. Finding the right formula so that the individual

sees the restrictions as working to his overall benefit represents a major challenge. It would seem more likely that the individual will set out to beat the system if it is imposed by the State than if it is seen to be devised and implemented by the industry itself. The general view in both Canada and Scotland is that the independence of the growers and merchants is such that the Dutch system could not work if applied generally in these countries.

A major difficulty over the years has been the uneven flow of material into the multiplication chain. The initiative of setting up a cooperative to improve this flow confronts a major difficulty of any seed system.

Cost

It is very difficult to compare the economic performance of the different sectors in terms of cost of production. There are several reservations about such exercises. Such conclusions can be, at best, broad and tentative in nature, since sources may not be strictly comparable. Sources and information must refer to the same groups. For example, it would be misleading to compare a sample of full-time holdings in one country with a sample of part-time holdings in another. The sample selection from the total population must be unbiased to ensure that the characteristics of the sample do not deviate from the characteristics of the population, and the conventions used for measuring costs and performance must be the same. Where monetary values are expressed in different currencies, meaningful comparisons will depend upon making appropriate conversions into a common currency. Such conversions should ideally reflect differences in purchasing power, but satisfactory methods of taking this into account are not available. Thus, in general, these requirements restrict comparisons. Exchange rate changes can have an important effect on comparisons and these will reflect the macro economic position of the country. We present in Appendix 1, Table 18 the only data on production costs. They are not strictly comparable and the data from the Netherlands and Scotland is derived from farm budgeting data for 1986.

There are some very broad conclusions which emerge. First, when viewed on a US dollar basis converted at current rates, the Canadian costs are much lower. The main reason is the much lower cost of seed. As was seen earlier, the Canadian system has a very substantial surplus of seed because a very high proportion of potatoes grown in key production areas such as PEI are certified. Also, under Canadian conditions, the costs of producing seed potatoes are not much different from those of producing ware potatoes. As a result, seed potatoes are sold at a very small premium over table potatoes. In fact, there are no data which distinguish prices according to use, but some of our informants suggested that a maximum of 10 per cent premium was obtained for seed over table potatoes.

In the United Kingdom and The Netherlands there are very clear differences in cost between seed and table production. In 1986 for example, Dutch farm-planning data indicated that the cost of seed sprays, fertilizer, and levies amounted to 3,100 guilders for table potatoes and 5,700 and 6,790 guilders respectively for free and monopoly variety seed (Appendix 1, Table 18). In the same year, table potatoes were budgeted to earn 220 guilders per ton compared with the 480 and 520 guilders per ton for seed potatoes of a free variety and monopoly variety respectively. In the United Kingdom, farm planning data suggests that variable table potato costs are 1,050 compared with 1,560 for commercial seed production (Appendix 1, Table 18). Table potatoes are budgeted to earn 70 per ton compared with seed at 110 per ton.

The main reasons for differences in Canadian and European costs are accounted for by the cost of the seed material used, and also by the higher spray costs and levies (Appendix 1, Table 18). In The Netherlands, the higher proportionate cost of sprays reflects, in particular, the higher bills for the use of nematicides, fungicides, and blight control. The difference in the levy element is quite considerable, highlighting the extent to which the Dutch sector funds its own activities. It must be borne in mind that even at this level there is a 50% subsidy of the certification costs, reducing the cost by approximately 400 guilders. The level of inspection charges and other levies in

the UK reflects the lower cost of maintaining a part-time potato inspection service compared with the cost in the Netherlands and the extent to which promotion and intervention charges fall less directly on the seed industry.

What is the Role of the State?

The State plays a very different role in each of the different seed systems. The boundaries between private and State activities are indicated in Table 17 by the continuous line. The activities above the line are principally the responsibility of the State, those below it the responsibility of the industry acting in concert or independently. It will be noted that a neat and tidy demarcation of responsibilities cannot be illustrated because of the nature of the institutional arrangements. The various notes to the table provide some qualification to the positioning of the boundary.

Comparison of state assistance to different industries is always difficult to quantify without wide consideration of the systems of taxation and resource distribution. However, it will be clear from the commentary above and from Table 17 that the Dutch industry is subject to far less government involvement than Canada and the United Kingdom. The reasons for government involvement are many as indicated in the introduction to this report. In many developed-country economies, the rationale for supporting agricultural production is being examined afresh. In the case of many of the basic commodities, surpluses and the high cost of budgetary expenditure have meant that reforms are slowly being introduced. Potatoes are the only major agricultural product not to have a common EC market-regulation policy. As a result, individual countries are able to follow their own policies. The rationale for supporting the Dutch seed potato industry is the enhancement of its economic efficiency and competitiveness. Apart from the state contribution to the funding of the certification service, there is no substantial distortion of market forces to give producers in any region or part of the region more advantage than any other. On the whole, the industry has been asked to fight its own battle using its own

Table 17. The responsibility of the State in the different systems examined⁺

Seed production	Breeding	Research & extension	Quality control	Promotion	Market regulation	Financial services	Other services
<i>The Netherlands</i>							
(2) Disease-free introduction	Plant introduction	Fundamental research	Quarantining	*Export promotion	*Market intervention	Credit	International representation
Initial multiplication	Germplasm maintenance	Applied research	*Testing services			Insurance	Plant breeders' rights, laws & administration
Production of seed	Fundamental research	*Extension	*(3) Variety assessment				Seed laws and administration
Seed trade	(1) Commercial breeding		*(4) Disease control measures				
	Commercialization of varieties		*(2) Certification				
<i>Canada - New Brunswick</i>							
Disease-free introduction	Plant introduction	Fundamental research	Quarantining	*(1) Export promotion	Market intervention	Credit	International representation
(1) Initial multiplication	Germplasm maintenance	Applied research	Testing services			Insurance	Plant breeder's rights, laws & administration
Production of seed	Fundamental research	Extension	Variety assessment				Seed laws & administration
Seed trade	Commercial breeding		Disease control measures				
	Commercialization of varieties		*Certification				
<i>Canada - Prince Edward Island</i>							
(4) Disease-free introduction	Plant introduction	Fundamental research	Quarantining	*(1) Export promotion	Market intervention	Credit	International representation
(1) Initial multiplication	Germplasm maintenance	Applied research	*Testing services			Insurance	Plant breeders' rights, laws & administration
Production of seed	Fundamental research	*Extension	*Variety assessment				Seed laws & administration
Seed trade	Commercial breeding		*(4) Disease-control measures				
	Commercialization of varieties		Certification				
<i>United Kingdom</i>							
(4) Disease-free introduction	Plant introduction	Fundamental research	Quarantining	*Export promotion	*Market intervention	Credit	International representation
(1) Initial multiplication	Germplasm maintenance	Applied research	*Testing services			Insurance	Plant breeders' rights, laws & administration
Production of seed	Fundamental research	*Extension	*Variety assessment				Seed laws & administration
Seed trade	(5) Commercial breeding		Disease control measures				
	(5) Commercialization of varieties		*Certification				

⁺ Activities above solid line are conducted by public sector, those below by private sector.
^{*} Some industry funding either through compulsory levies or charges for services
(1) Some public participation
(2) Subject to public supervision of standards
(3) Initial valuations are organized and administered privately by the industry
(4) Some private participation
(5) One important publicly-funded breeding station and State variety-development agency privatized in 1987

resources. However, the Dutch government has only taken this stance because it is recognized that the Dutch seed potato sector is very well placed to compete internationally. If, for example, a major disease problem should emerge (such as bacterial ring rot) then the full resources of the State would be brought to bear to resolve the problem. The relatively low level of cost recovery of the certification service is an anomaly. This funding was increased at a time when the Dutch seed sector was thought to be at a disadvantage when compared with its European competitors. The extent of cost recovery in other countries has increased, but no similar move has occurred in The Netherlands although the overall funding of the service has been constrained.

The situation in Canada is very different. The PEI and New Brunswick industries represent important features of a disadvantaged regional economy. As a result, they are given a substantial element of aid. This assistance has enabled the federal and provincial governments to take a number of initiatives to improve the seed potato industries and their performance. In particular there has been the introduction of publicly-funded Elite seed farms and laboratories for producing disease-free material. These innovations have helped consolidate the position of the State as the essential backbone of the industry. This also applies in PEI where greater direct industry participation is apparent, and where the PMB has played a major role in organizing the sector.

In Scotland, state support has been important but the situation is changing quite dramatically as public expenditure is restricted. Thus, there has been a substantial change in the orientation of government support to research, extension and training. Much more is being asked of the industry: it is being asked to itself organize and implement "activities for the common good." This situation has changed quite dramatically and the greater participation of private industry in breeding, quality control, and market regulation is indicative of this. A major challenge for the industry is to find the funding to continue these activities as the government withdraws its support. Compared with their Dutch counterparts, those in the British agricultural sector have been used to having more of these activities provided from

the government and the transition will be painful.

How Much Seed Should be Produced?

In formalized seed programs in less developed countries, the issue of how much to produce is a key question. Because the value of certified seed is not always obvious, there is a need to actively develop targets and to produce according to those targets as part of an extension package which will include a variety of incentives and inducements. The dangers of such programs are well understood. Over-production of high grade material can reduce the economic incentives for the production of later-generation seed material and then the seed multiplication system crumbles. Seed programs in developed countries are more aware of the dangers involved. Control over the quantity entering the multiplication chain involves the assumption of substantial responsibility for the economic situation of the potato sector. Restriction of supplies will increase prices and put extra pressure on growers who use potato seed while encouragement of supplies will put pressure on those who produce potato seed. The prudent seed-program administrator in developing countries has to be very market aware in making his decisions on the material to release and, because of the vagaries of the potato market, is unlikely to escape unscathed.

The mature formal seed potato systems of developed countries tend not to obviously or directly influence the supply of material because of the serious implications of making mistakes. However, there is some difference in the emphasis given here. For example the Dutch sector operates a completely free-market system. The amount of material multiplied each year is determined solely by the demand from the industry. There is also complete freedom for anyone to become a high-grade grower and to apply for disease-free material. However, having applied for material, the seed grower has to attain all the standards set for the grade. These standards are onerous and the costs of failing to meet them are high, thus there is little fear of inadequate skills or expertise lowering the standards. The safety valve for the Dutch is

STOPA, which will purchase any surpluses. This is seen as a far more acceptable way of dealing with the problem than trying to ration disease-free seed initiations, as it represents far less distortion of market forces. The disciplines of the market are reinforced by STOPA as substantial intervention purchases for any given variety are heavily penalized by higher STOPA levies in following years.

In Scotland and in New Brunswick, Canada there is also reluctance to interfere with the supplies coming onto the market although there has been an element of control. In these countries there are restrictions on those who produce high-grade seed. In order to join the club, the high-grade seed growers have to meet certain requirements in terms of past record, as well as fulfill specified criteria in terms of facilities. Also, because central agencies have been concerned with the release of disease-free stock there is more influence over the supplies available. This influence is rarely specific or formal, but it is there, simply because of the pivotal position of the central disease-free supply. In Prince Edward Island even more control applies as the main grower of Elite stocks is the PMB. However, even though the PMB has control, there has been little evidence from this study that the PMB has made any substantial errors in its release policy for disease-free stocks. The one manifestations of difficulty are the inevitable concern over creating temporary monopolies as a result of the system and the call for the introduction of regulated selling of seed all the way down the multiplication chain through PMB-determined contract conditions covering prices. This would be anathema to the Dutch approach. The island status of the PEI industry, the importance of exports off the island and the fact that the PEI industry is not producing seed-quality potatoes just for seed use makes this a special case.

In Scotland, an attempt to control the supply has been made through the VT Growers Ltd. This organization attempts to coordinate its decisions in relation to high grade material initiations of free varieties. While there could be reservations on account of restriction of competition, few objections have been made, probably because there is still a substantial proportion of material which is not moving through VT Grower members (especially

monopoly varieties) and because the organization does not formally control supplies. Also, there are a considerable number of persons further down the seed chain who benefit from a more rational availability of seed. In the absence of the wholesaling structure and the kind of seed-industry, market support which exists in The Netherlands, such methods appear defensible as long as competition is not restricted.

One key activity for the common good in this area is the availability of sound market information. A major problem is the availability of a very informal information system in relation to the market situation for different varieties. Indeed it is only very recently that the Scottish industry has developed a system which collates for each variety how much material is at each stage of the multiplication chain. Given the absence of such basic information it is easy to understand why the initiation of material into the seed chain may not coincide with future market requirements. As far as free varieties are concerned, there seems to be a strong argument for investing in a better information structure to ensure that the market works more efficiently rather than introducing more measures of control.

Postscript; New Technologies and the Future

This report is being written at the time of possible, considerable change for seed potato production. New technologies are emerging which reduce the period of multiplication and improve the health status of the resulting seed material. As will be seen in this report, micro-propagation has already made an important impact on the countries considered. However, micropropagation techniques are becoming more sophisticated and highly developed, with the promise of material produced by novel protocols appearing on the market very soon (see the UK section of this report). These promise to reduce even further the length of the multiplication chain as the efficiency of in vitro/glasshouse production increases. If these technologies are successful (and currently major investments are being made), then the seed potato sector will change quite profoundly as the

area of seed potato production required will be reduced. In advance of the commercial application of the most recent technologies it is difficult to be precise about the future shape of the seed potato sector. It is inevitable that contraction of the number of producers and seed area will occur and the institutional arrangements described in the foregoing sectors will need to adjust to this.

The immediate impact is likely to fall on seed production at the top of the multiplication chain for it is here that in vitro/glasshouse methods are more competitive. In some respects the new technologies challenge some of the basic and most fundamental characteristics of the seed industry. For the countries considered, adjustments will be essential if international competitiveness is to be maintained and a reconsideration of the role and function of many aspects of its seed sector will be demanded.

Appendix 1. Statistical Appendix

Table 1. Production of potatoes ('000 tons)

Year	GB	Netherlands	Canada
1955	5,609	3,907	NA
1956	6,766	3,216	NA
1957	5,110	3,741	NA
1958	5,062	3,606	NA
1959	6,293	3,141	NA
1960	6,558	3,974	NA
1961	5,728	3,552	NA
1962	6,109	3,794	NA
1963	6,024	3,625	NA
1964	6,514	3,882	2,147
1965	7,065	3,073	2,077
1966	6,104	3,934	2,480
1967	6,674	4,840	2,119
1968	6,402	5,166	2,398
1969	5,820	4,853	2,351
1970	7,076	5,796	2,500
1971	7,020	5,920	2,219
1972	6,223	5,752	1,997
1973	6,534	5,950	2,162
1974	6,494	6,290	2,506
1975	4,308	5,283	2,198
1976	4,458	5,060	2,347
1977	6,156	5,970	2,522
1978	6,980	6,505	2,513
1979	6,137	6,613	2,771
1980	6,707	6,539	2,480
1981	5,869	6,747	2,647
1982	6,539	6,552	2,781
1983	5,525	5,796	2,556
1984	6,985	7,056	2,799
1985	6,596	7,450	3,029
1986	6,122	7,191	2,825

Source: Statistics Canada, Reference handbook, vegetables: March, 1985. Handbook of selected Agricultural Statistics (Canada), various. Potato Marketing Board: Historical data. Landbouwcijfers, various years. Produktschap voor aardappelen, various. Statistics yearbook (Netherlands), various.

Table 2. Area of potatoes ('000 ha)

Year	GB	Netherlands	Canada
1964	298.0	124.0	112.2
1965	299.0	125.0	119.5
1966	292.0	131.0	129.0
1967	287.0	138.0	123.0
1968	283.0	149.0	122.7
1969	242.0	149.0	123.5
1970	249.0	157.0	127.8
1971	234.0	154.0	109.1
1972	210.0	149.0	98.5
1973	196.0	157.0	105.1
1974	218.0	159.0	113.8
1975	210.0	151.0	104.8
1976	211.0	161.0	106.8
1977	209.0	170.0	112.0
1978	207.0	161.0	110.5
1979	200.0	166.3	112.8
1980	192.0	172.7	107.2
1981	182.0	165.0	110.5
1982	172.0	166.0	113.4
1983	169.0	163.5	113.0
1984	168.0	160.7	117.6
1985	165.0	168.7	122.1
1986	161.0	167.1	116.6

Source: Statistics Canada, Reference handbook, vegetables: March, 1985. Handbook of selected Agricultural Statistics (Canada), various. Potato Marketing Board: Historical data. Landbouwcijfers, various years. Produktschap voor aardappelen, various. Statistics yearbook (Netherlands), various years.

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Table 3. Yield of potatoes (t/ha)

Year	GB	Netherlands ^a	Canada
1964	22.50	33.3	19.10
1965	25.20	26.8	17.40
1966	24.20	32.0	19.20
1967	25.00	36.8	17.20
1968	24.70	34.3	19.50
1969	25.20	32.3	19.00
1970	28.20	35.5	19.60
1971	29.20	37.5	20.30
1972	28.00	37.5	20.30
1973	31.00	36.9	20.60
1974	32.00	39.3	22.00
1975	22.30	33.2	21.00
1976	21.40	29.6	21.97
1977	28.80	34.3	22.52
1978	34.90	38.6	22.74
1979	32.50	37.9	24.57
1980	35.10	36.0	23.13
1981	32.90	39.1	23.95
1982	36.50	37.8	24.53
1983	30.30	33.0	22.61
1984	37.80	41.7	23.80
1985	36.90	42.4	24.80
1986	36.70	41.2	24.20

Source: Statistics Canada, Reference handbook, vegetables: March, 1985. Handbook of selected Agricultural Statistics (Canada), various. Potato Marketing Board: Historical data. Landbouwcijfers, various years. Statistics yearbook (Netherlands), various years.

a Yields: weighted average of table and starch, weighted by production totals.

Table 4. Index of prices of potatoes in current terms (1965-69 annual average = 100)

Year	GB ^a	Netherlands ^b	Canada ^c
1964	82	83	145
1965	83	125	131
1966	113	103	76
1967	85	48	94
1968	90	79	84
1969	129	145	115
1970	84	64	109
1971	88	63	93
1972	114	156	175
1973	111	97	269
1974	150	96	137
1975	615	285	259
1976	779	307	199
1977	253	69	163
1978	262	104	186
1979	348	109	161
1980	262	121	369
1981	495	184	272
1982	314	108	247
1983	744	320	258
1984	290	100	287
1985	338	80	214

Source: Statistics Canada, Reference handbook, vegetables: March, 1985. Handbook of selected Agricultural Statistics (Canada), various. Potato Marketing Board: Historical data. Landbouwcijfers, various years. Produktschap voor aardappelen, various. Statistics yearbook (Netherlands), various years. Eurostat: Financial statistics, various.

a Average ex-farm price: ware potatoes.

b Growers price for table potatoes grown on clay.

c Average ex-farm prices, subsidy excluded.

Table 5. Prices of potatoes in real (1975) terms

Year	GB ^a Pounds/t	Netherlands ^b gld/ton	Canada ^c can \$/ton
1964	32.98	285.50	112.30
1965	32.53	402.10	99.00
1966	42.38	314.00	55.60
1967	31.35	143.20	65.60
1968	31.83	226.30	56.60
1969	42.57	384.80	74.10
1970	26.43	164.20	67.80
1971	25.12	149.20	56.30
1972	30.63	342.00	101.70
1973	27.09	195.40	144.90
1974	31.55	177.90	66.50
1975	103.90	477.50	113.30
1976	112.94	473.80	81.20
1977	31.71	99.70	61.70
1978	30.27	144.80	64.40
1979	35.47	145.70	51.20
1980	22.65	151.30	106.40
1981	38.20	215.80	69.90
1982	22.34	120.20	57.10
1983	50.59	345.20	89.50
1984	18.77	104.50	60.10
1985	20.64	81.20	43.00

Source: Statistics Canada, Reference handbook, vegetables: March, 1985. Handbook of selected Agricultural Statistics (Canada), various. Potato Marketing Board: Historical data. Landbouwcijfers, various years. Statistics yearbook (Netherlands), various years. Eurostat: Financial statistics, various.

Note: See Table 4.

Table 6. Price of potatoes in current terms (US\$/ton)

Year	GB ^a	Netherlands ^b	Canada ^c
1964	38.47	37.53	59.20
1965	38.86	56.43	53.50
1966	52.97	46.85	31.20
1967	36.05	21.87	38.10
1968	38.20	35.78	33.50
1969	54.28	65.61	45.80
1970	35.68	29.16	44.30
1971	37.05	33.13	37.80
1972	48.25	81.17	76.90
1973	53.63	58.00	117.90
1974	59.48	59.76	60.00
1975	229.87	188.61	111.00
1976	236.65	194.86	89.00
1977	74.71	47.36	67.30
1978	84.93	80.27	71.60
1979	124.60	90.95	60.00
1980	103.02	101.25	137.50
1981	167.24	129.57	99.20
1982	92.83	68.07	87.60
1983	190.55	188.66	130.70
1984	65.13	52.08	101.80
1985	73.06	40.05	72.10

Source: Statistics Canada, Reference handbook, vegetables: March, 1985. Handbook of selected Agricultural Statistics (Canada), various. Potato Marketing Board: Historical data. Landbouwcijfers, various years. Produktschap voor aardappelen, various. Statistics yearbook (Netherlands), various years. Eurostat: Financial statistics, various.

Note: See Table 4.

Table 7. Canadian seed potato export destinations (tons)

Year ^a	USA	America ^b	EEC ^c	Others	Total
1963	33,370	55,942	11,472	266	101,050
1964	56,089	51,975	12,557	177	120,798
1965	35,389	40,318	14,414	363	90,484
1966	56,792	62,169	15,172	553	134,686
1967	23,734	50,861	11,526	413	86,534
1968	45,734	62,995	14,629	117	123,475
1969	31,678	92,735	17,9329	9	142,354
1970	24,441	67,189	11,240	52	102,922
1971	16,335	55,133	9,590	3	81,061
1972	13,808	77,735	14,282	15	105,840
1973	33,460	36,997	19,039	1	89,497
1974	20,462	42,773	12,532	3,687	79,413
1975	18,569	74,068	14,616	4,843	112,096
1976	10,765	53,730	25,254	25,458	115,208
1977	27,003	41,643	9,965	23,249	101,860
1978	24,186	52,577	13,424	3,901	94,088
1979	23,963	77,872	17,751	3,034	122,620
1980	61,813	72,931	14,344	5,958	155,047
1981	54,380	55,708	23,542	50	133,680
1982	28,113	51,343	16,108	4,034	99,598
1983	25,788	51,654	23,911	11,995	113,347
1984	43,699	45,017	22,483	12,328	123,526
1985	34,952	42,610	13,791	2,523	93,876

Source: Statistics Canada. Statistical data on Canadian certification.

a. Calendar years 1963/77, crop years after 1977.

b. Excluding USA.

c. EEC (12) except 1974/77 inc., when EEC (10) Spain and Portugal included in Others 74/77.

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Table 8. UK seed potato export destinations (tons)

Year	Portugal	Spain ^a	Algeria	Egypt	Cyprus	Morocco	Others	Total
1974	25,458	14,858	1,621	7,309	3,447	2,200	27,125	82,018
1975	24,279	20,411	23,782	5,624	4,890	1,781	22,457	103,224
1976	23,002	18,592	7,074	6,050	5,240	0	6,535	66,493
1977	24,020	13,277	2,050	10,994	8,625	600	14,170	73,736
1978	16,871	14,343	9,199	17,284	2,390	4,297	21,751	86,135
1979	13,821	21,122	20,828	17,491	7,128	2,497	25,104	107,991
1980	33,924	17,560	36,024	12,804	12,426	7,030	14,765	134,533
1981	27,105	17,409	35,859	9,137	5,593	4,458	14,818	114,379
1982	38,231	16,961	21,190	9,165	4,900	7,618	15,634	113,699
1983	17,733	18,388	21,006	8,368	3,710	9,066	13,812	92,083
1984	45,109	18,621	20,152	10,785	4,054	7,584	20,344	126,649
1985	29,748	16,820	36,676	5,130	1,546	12,874	12,004	114,798

Source: Eurostat CCT-Nimex, various.

a Including Canary Islands.

Table 9. Dutch seed potato export destinations^a ('000 tons)

Year	Total	Asia	Africa	America ^b	EEC	Rest/Eur
1960	223	5	30	3	165	20
1961	254	6	36	3	183	26
1962	262	6	40	4	185	27
1963	268	7	41	6	192	22
1964	258	8	32	7	184	27
1965	264	8	33	6	186	31
1966	283	9	34	8	200	32
1967	289	12	33	8	200	36
1968	283	11	32	8	198	34
1969	286	14	32	9	198	33
1970	286	14	38	10	193	31
1971	299	17	40	12	198	32
1972	310	18	45	18	194	35
1973	330	21	48	21	206	34
1974	325	21	47	26	196	35
1975	345	23	49	25	211	37
1976	345	20	50	26	209	40
1977	382	24	55	29	230	44
1978	404	30	69	33	228	44
1979	427	36	70	36	234	51
1980	441	38	78	37	230	58
1981	449	46	79	30	232	62
1982	441	47	90	24	230	50
1983	476	50	110	22	241	53
1984	476	54	106	20	262	34
1985	541	61	159	15	273	33

Source: Jaarverslag, Produktschap voor aardappelen, various.

a Three year moving averages.

b Including USA.

Table 10. Seed potato area (ha)^a

Year	Netherlands	GB
1971	20,297	23,800
1972	19,559	22,300
1973	18,539	20,600
1974	20,419	18,500
1975	21,870	18,200
1976	25,640	17,100
1977	27,279	19,400
1978	30,810	23,100
1979	31,819	24,300
1980	32,622	23,600
1981	31,007	22,200
1982	29,982	22,100
1983	31,643	22,200
1984	31,451	21,700
1985	33,680	20,400
1986	34,274	18,200

Source: Produktschap yearbook, various.
Beschrijvende voor landbouwgewassen, various.
NAK Jaarverslag, various. PMB, DAFS, MAFF.

a No data on Canada available.

Table 11. Dutch seed potato production disposal ('000 tons)

Year	Domestic sales	Own use	Exports	Intervention	Residual
1973	142	58	306	8	37
1974	148	62	352	2	61
1975	154	66	300	0	19
1976	188	50	380	0	16
1977	153	60	346	0	27
1978	208	50	422	23	143
1979	196	50	425	64	93
1980	204	50	437	39	170
1981	212	50	452	16	150
1982	202	50	473	29	134
1983	177	50	394	1	85
1984	215	50	567	44	126

Source: Produkschap yearbook, various.
Beschrijvende voor landbouwgewassen, various.
NAK Jaarverslag, various.

Table 12. Dutch seed potato yield (t/ha)

Year	Yield (t/ha)	Year	Yield (t/ha)
1968	27	1977	22
1969	27	1978	29
1970	29	1979	27
1971	30	1980	28
1972	31	1981	30
1973	30	1982	31
1974	31	1983	23
1975	25	1984	33
1976	26	1985	34

Source: Produkschap yearbook, various.
Beschrijvende voor landbouwgewassen, various.
NAK Jaarverslag, various.

Table 13. Dutch seed potato area, by class (ha)

Year	S	SE	E	A	B	C
1977	232	560	4,918	14,535	5,022	1,573
1978	382	521	11,686	14,251	2,574	1,277
1979	NA	NA	NA	NA	NA	NA
1980	766	1,461	12,441	15,864	1,274	753
1981	761	1,184	10,633	16,337	1,381	666
1982	951	1,489	10,998	14,948	1,067	538
1983	659	698	8,741	18,959	1,948	612
1984	953	981	10,156	17,580	1,191	403

Source: Produkschap yearbook, various. Beschrijvende voor landbouwgewassen, various. NAK Jaarverslag, various.

Table 14. Dutch seed potato area, by variety (ha)

Year	Jaerla	Ostara	Bintje	Spunta	Desiree	Others
1970	461	327	6,771	93	666	266
1971	731	452	6,468	153	741	401
1972	623	450	6,771	272	780	233
1973	734	431	6,327	462	821	490
1974	1,006	568	6,865	774	840	305
1975	1,064	701	7,137	978	1,124	367
1976	1,189	829	8,844	1,062	1,272	640
1977	1,372	1,122	8,502	1,436	1,525	483
1978	1,382	1,165	9,595	1,806	1,967	750
1979	1,441	1,072	10,544	1,849	2,068	523
1980	1,491	1,013	10,185	2,164	2,219	709
1981	1,506	998	8,883	2,477	2,128	547
1982	1,529	1,022	8,283	2,531	2,120	559
1983	1,574	1,182	8,844	2,726	2,294	1,092
1984	1,480	1,189	8,121	2,681	2,362	1,051
1985	1,686	1,172	8,389	2,929	2,255	1,039
1986	1,859	1,152	7,651	3,084	2,367	1,163

Source: Produkschap yearbook, various. Beschrijvende voor landbouwgewassen, various. NAK Jaarverslag, various.

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Table 15. Canadian seed potato production, by class ('000 tons)

Year	EI	EII	EIII	Foundation	Certified	Total
1963				208	212	420
1964				203	231	434
1965				236	224	460
1966				313	303	616
1967				318	326	644
1968				322	324	646
1969		14		333	251	598
1970			23	372	233	628
1971	1	4	24	208	358	595
1972	1	4	24	202	271	502
1973	1	4	25	181	247	458
1974	1	4	31	197	302	535
1975	1	4	27	186	265	483
1976	1	4	28	176	289	498
1977	2	4	36	230	347	619
1978	1	8	32	273	316	630
1979	2	12	31	344	360	749
1980	2	11	33	337	309	692
1981	2	13	29	331	343	718
1982	2	13	31	391	312	749
1983	2	8	45	337	297	680
1984	1	8	44	328	281	662
1985	NA	NA	NA	NA	NA	680

Source: Statistical data on Canadian certification.

Table 16. Canadian seed potato area, by variety (ha)^a

Year	Kennebec	Red Pontiac	Burbank	Sebago	Shepody	Superior
1963	5,681	1,154	2,275	8,665		
1964	5,919	901	2,435	6,960		
1965	6,066	1,102	3,301	7,617		
1966	7,583	822	3,837	10,816		
1967	10,332	1,059	3,888	10,747		
1968	10,542	810	3,706	10,388		108
1969	10,832	654	3,642	9,365		66
1970	10,944	758	4,569	9,255		34
1971	9,417	1,172	4,760	8,232		61
1972	8,218	984	3,832	6,468		132
1973	8,495	911	3,534	5,400		158
1974	10,074	1,022	3,484	6,361		299
1975	10,414	1,088	4,263	5,073		398
1976	10,437	1,187	2,428	4,625		612
1977	12,299	1,718	5,218	4,337		1,083
1978	12,097	1,675	7,148	5,056		1,821
1979	12,095	1,618	8,350	5,623		2,292
1980	10,610	NA	NA	NA	NA	NA
1981	10,485	NA	NA	NA	NA	NA
1982	10,652	1,574	11,869	3,401	394	3,640
1983	9,648	1,687	11,399	2,874	872	3,478
1984	9,468	1,991	12,369	3,201	1,175	3,998
1985	7,506	1,739	12,913	2,143	2,143	4,180

Source: Statistical data on certification.

Note: a Leading six varieties only.

Table 17. Great Britain percent of seed potato area certified, by variety

Year	Estima	Wilja	Desiree	King Edward	Maris Piper	Pentland Squire	Record	Pentland Dell
1976		1	10	15	10	1	9	4
1977		2	11	12	10	2	9	3
1978		1	14	9	13	4	10	4
1979	2	2	21	8	16	6	9	5
1980	3	6	17	10	16	6	9	5
1981	1	5	25	8	13	7	10	5
1982	1	7	20	7	16	7	10	5
1983	3	8	22	4	15	7	10	5
1984	4	8	22	3	15	7	11	5
1985	4	7	25	2	12	7	12	4
1986	6	5	26	1	11	8	13	6

Source: PMB, DAFS, MAFF.

Table 18. The relative importance of some key variable costs

	Netherlands						Canada		Scotland	
	Monopoly variety		Free variety		Table potato		Seed and table		Seed potato	
	Hfl	%	Hfl	%	Hfl	%	Can \$	%	£	%
Seed	2,033	30	1,840	32	1,155	37	246	23	640	50
Fertilizers	580	9	573	10	799	26	285	27	130	10
Sprays	2,050	30	2,038	36	1,125	36	467	43	360	28
Insurance	47	1	45	1	28	1	61	6	0	0
Levies	2,080	31	1,240	22	10	0	16	1	145	11
Total	6,790	100	5,736	100	3,117	100	1,075	100	1,275	100

Source: J.W. Anderson, Budget aid for potatoes, personal communication. Kwantitatieve Akkerbouw Informatie 1986/7. McGiffen (1987).

Note: The Scottish figure for sprays involves an element of subcontract.

Appendix 2. Estimated Domestic Seed Requirement and Certified Seed Use

	GB 1985	Canada 1985	Netherlands 1984
Domestic production			
Domestic seed area ('000 ha)	20.5	35.3	31.5
Gross yield of potatoes (t/ha)	40		
Net yield of potatoes (t/ha)	38	25	33
Net yield of seed (t/ha)	22	10.9	31
Estd. cert. seed production ('000t)	779	871	1,038
Estd. cert. production for seed use ('000t)	451	385	975
Storage losses (10%)	(45)	(38)	(97)
Seed from imports ('000t)	24	10	0
Less intervention sales ('000t)			(44)
Less exports ('000t)	(65)	124	(567)
Total cert. seed available on domestic farms ('000t)	365	233	266
Total area planted ('000 ha)	179	122	109
Average seed rate (t/ha)	3.1	2.1	2.6
Total seed requirements ('000t)	555	257	282
Estimated % planted with certified seed	66%	91%	94%

Source: Produktschap voor Aardappellen Annual Report. Potato Marketing Board. Scottish Agricultural Colleges Technical Note 109. Canadian Farm Product Marketing Council. McGriffin, Overview of costs and returns in Canadian potato production 1985.

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Appendix 3. Overview of the Potato Industries of New Brunswick and Prince Edward Island

New Brunswick Potato Industry Overview

Importance of Potatoes

In New Brunswick potatoes represent roughly one quarter of all farm cash receipts and account for average annual sales of some \$40m Canadian at the farm gate.

Production, Yields, and Area

The province produces just over half a million tons per annum which represents roughly 20% of the total Canadian crop. Yields have varied considerably in recent years from between 24 to 31 t/ha. The area has stabilized in recent years at roughly 22,000 ha. There are just under 600 producers growing the crop with the average area of potatoes per farm at roughly 30 ha. This has increased since the mid 1970's from about 24 ha.

The Structure of Production and Location

Potato farmers are reputedly younger than other farmers in New Brunswick and have a much greater dependence on their farm for income. There is a heavy reliance on returns from the potato crop for their total income. Potato production is concentrated in the upper St. John River valley since the 1940's and this pattern has not changed in recent years.

Utilization

In recent years 10% of the total crop was utilized as seed, 16% went to table stock markets, and 50% to processing. The remaining 24% has been classified as wastage and was either fed to livestock or dumped. In recent years the traditional pattern of markets for New Brunswick has changed with processing demand levelling off and a reduction in sales of table stock to other Canadian provinces as a result of increased production in those areas. Off-shore export sales are stagnant, but the United States is now well established as being the most important destination of table-stock potatoes from New Brunswick, taking 55% of all table stock moved. This is in sharp contrast to the pattern in the middle of the 1970's when only very small quantities moved to the United States.

Seed Markets

The majority of seed potatoes are utilized in the province (42%) with the other major market being other Canadian provinces (22%), off-shore markets (16%), and the United States (20%). Total seed sales are estimated to have reduced slightly due to reductions in off-shore export markets. In recent years the United States market has become relatively more important and the off-shore market less important. Seed sales to the United States represent between 40% and 60% of total seed exports.

Marketing Channels

Most of the shippers are also producers and they sell largely to brokers for sales in the United States. All shippers are licensed by the NBPA. Only a relatively small group of shippers are involved in exporting, and seed for export is often grown under contract by the exporters themselves.

Prices

Potato prices are freely negotiated although for sales to the processing industry the NBPA negotiates on behalf of farmers. In the seed market there is very strong competition between New Brunswick and PEI. There is very little premium for seed potatoes over table stock.

Quality

The growth of the processing industry has brought about a reorientation of production towards the processing industry and the processors have put a major effort into obtaining appropriate processing quality. This has had an influence on the varieties grown. There is a general concern over the quality of the prepacked product and this is becoming particularly important as washing is increasing. Roughly half of the table potatoes sold from New Brunswick are washed.

Resources and Technology

General levels of fertility in the soils used for potato production are high, although there has been some concern over a depletion of soil resources in areas of high intensity potato production. Planting and harvesting is highly mechanized with virtually all seed being cut, and most harvesting done by mechanical harvesters. The sector has adequate storage facilities although much of the storage is quite old and does not include adequate ventilation. A big investment in storage is required to meet the challenge of obtaining higher quality for the market. Novel propagation methods are now used, routinely as the source of disease-free material for initial seed multiplications.

Transport

Almost all the transport of potatoes is done by road and this has led to a sharp decrease in losses. The cost of transport to the major markets is significant, and there is concern within the province that New Brunswick potatoes are at a substantial disadvantage when compared to PEI potatoes because of the different subsidies available for transport. St. John has facilities for storing and inspecting exported potatoes but this is some considerable distance from the main production areas.

Organization

The Department for Agriculture and the NBPA carry out a number of central supporting functions for the potato industry. The latter agency is funded by levy and is involved in promotion, licensing, and negotiation with processors as well as administering certain federal schemes. Its role is far more limited than the equivalent body in PEI.

Promotion

The NBPA, with the cooperation of the Department, potato shippers, and seed growers, is involved in promotion in seed and table markets. All export promotion of seed-potatoes is undertaken through Potatoes Canada, the Canadian seed-potato export agency. This is a joint venture of Agriculture Canada, the Department for External Affairs, and the governments of PEI and New Brunswick together with organizations representing PEI and New Brunswick growers and seed exporters. There have been substantial difficulties in maintaining cooperation for this export effort.

Market Situation

Although the medium-to-long-term market prospects are only fair, there are opportunities for New Brunswick potatoes. Within New Brunswick it is estimated that one third of the total table-stock market is supplied by non-New Brunswick suppliers. Better storage and earlier harvests could reduce the requirement for late and early-season imports. In other Canadian markets, New Brunswick relies for its opportunities on maintaining quality and on a reputation for meeting the requirements of the market. In the seed market, there are opportunities as long as the province can maintain a reputation in other provinces for a higher health standard. There are great efforts within Ontario and Quebec to increase the level of local seed production which will make market development for New Brunswick potatoes that little bit harder. The United States offers substantial opportunities for the development of both seed sales and table stock markets, and exports to the United States have increased in recent years. There is a very large market on the eastern seaboard for table stock and the health status of Canadian seed potatoes should continue to offer prospects in the United States seed market. These opportunities depend to a large extent on the maintenance of good trade relations between the United States and Canada. The problems of maintaining New Brunswick's position in the domestic and international seed market has prompted the close examination of how improvements in product quality and marketing can be achieved.

Overview of the PEI industry

Importance of Potatoes

On average, potatoes represent 35% of total farm receipts over the last 10 years and account for average annual farm-gate sales of almost \$ 60m Canadian. PEI produces, on average, one quarter of the total Canadian potato production and accounts for roughly 65% of total seed production (although only 36% of sales), 30% of table stock exports, and 55% of seed exports.

Seed Potato Systems in Developed Countries: Canada, The Netherlands and Great Britain

Production, Yields, and Area

Potato production varies considerably although in recent years it has averaged around 800,000 tons. The area averages roughly 28,000 ha and this has increased consistently since the mid-1960's. Yields in recent years average at about 28.5 t/ha, the highest in Canada.

The Structure of Production and Location

There are approximately 650 potato farms registered in PEI with roughly 1,000 growers producing on average 45 ha per grower. There are some producers growing potatoes on a very large area. While potatoes are grown throughout the province, in recent years there has been greater concentration in central Prince county which now accounts for 60% of the total area.

Utilization

While year-to-year variations can be large, data over the last seven years suggests that, on average, 43% of the potatoes produced in PEI are shipped out of the province as table stock, 21% as seed with 14% being used locally for processing, seed, or table use. Culls and wastage account for some 22% of the total crop. Of the total table potato shipped, roughly 75% go to other Canadian markets and 25% are exported. The United States accounts for 60% of table exports.

Seed Markets

The majority of potatoes sold as seed are utilized in PEI (41%), with 13% sold to other Canadian provinces and 46% exported. More than 80% of the exports are to off-shore markets of which the most important are Venezuela, Uruguay, Portugal, and Spain. In recent years there has been a tendency for exports to be relatively less important compared with sales to the Canadian market.

Marketing Channels

In the domestic market there are 100 licensed dealers on the Island who sell to brokers or dealers in the main consumption area. There are only a very small number of dealers who are licensed as exporters (7). These exporters are licensed by Agriculture Canada and by the Potato Marketing Board.

Prices

There is industry negotiation of contract prices for sales to processing through the Potato Marketing Board. The Potato Marketing Board provides a market information service for the industry and maintains, at certain periods, minimum prices at which potatoes can be sold off the Island. Sanctions are imposed on farmers who do not abide by this discipline. As in New Brunswick there is very little premium for seed potatoes over table stock when sold on the domestic market.

Quality

Almost three-quarters of the potatoes are inspected to seed standard and together with the various additional measures to combat diseases, quality tends to be high. However, the level of wastage and culls can be very high suggesting that there is much room for improvement.

Resources and Technology

The PEI potato industry is quite highly mechanized with the bulk of seed being cut mechanically. Soils are generally good and highly fertile, although there is a traditional concern over soil compaction with resulting losses of productivity. In recent years greater attention has been devoted to improving quality and various technical innovations have been used to reduce bruising, etc. Storage capacity is adequate but there is still a need for better facilities for insulation, ventilation and humidity control. On packing lines, washing and count-carton packing capabilities are increasing.

Transport

All off-shore exports are shipped by boat with the rest shipped by road using roll-on/roll-off ferries although there is still some movement by rail. The two deep water ports available on the Island are only open for nine months of the year. Transport to and from the Island are kept open by icebreaker ferries.

Organization

The most important organization concerned with the seed potato industry is the PEI Potato Marketing Board. This is funded by levies, licenses, and seed sales and undertakes a wide range of functions for the common good of the industry. This organization also administers the Elite seed farm. The position of the Potato Marketing Board has been questioned in recent years and its future is currently under review because of lack of support during a recent plebiscite. The Potato Marketing Board is supported by both provincial and federal governments in a number of activities especially in relation to research extension and disease control.

Promotion

The Potato Marketing Board has principal responsibility for potato promotion although certain activities are undertaken by the Department of Agriculture. In export markets the PEI industry contributes toward the activities of Potatoes Canada.

Market Situation

The PEI potato industry has identified the export market for seed as offering the greatest potential for expansion. It is felt that the Islands production is internationally competitive but that it lacks an appropriate range of varieties, seed sizes, and the commercial channels for promoting PEI seed. The introduction of plant breeders' rights is eagerly awaited. In addition, there is anticipated to be substantial potential for developing sales of seed to the United States market, particularly if the yellow-fleshed market can be developed using imported genotypes. There is still considered to be substantial potential for the development of processed products and for developing sound relationships with

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processors in this respect. Sales into the table-stock market are not considered to offer a very bright future although there may be opportunities for developing speciality lines. PEI potatoes are traditionally sold at a premium on the Canadian market and their characteristic appearance is a result of being grown in very red soils has assisted this. Future prospects in the table stock market depend on maintaining the reputation which PEI has for quality.

Appendix 4. Dutch Seed Potato Sector Organizations

COA Organization for the development of new potato varieties and the promotion of plant breeding in The Netherlands.

The COA was established in the 1930's with the responsibility of promoting the production of new varieties in The Netherlands. The aim was to act as an extension service to improve the performance of potato breeders. Originally it worked closely with the IVP and since the establishment of SVP it has worked closely with that organization. In addition it organizes pre-selection trials as a basis for identifying which of the new varieties identified by private breeders might be submitted to official trials. It is funded by levy on breeders but some of its costs have been met by official government organizations. Funds are also allocated by the NAK and by the Landbouwschap.

DLO Directorate for Agricultural Research, Ministry of Agriculture and Fisheries

The DLO is responsible for overall management of agricultural research carried out in all 34 research institutes under the Ministry of Agriculture and Fisheries. As the principal source of finance for these institutes, a large part of its work is concerned with budgeting and controlling the finances of agricultural research carried out within these institutes.

IPO Institute for Research on Plant Protection

The IPO is concerned with many aspects of plant protection. It is involved in long-term research on the diseases and pests in agricultural and horticultural crops. It is also concerned with the development and improvement of methods for diagnosis of diseases on behalf of the inspection services. In addition, it distributes materials to private breeders and publicly-funded breeding institutes for use in disease tests in their selection work.

IVP Department of Plant Breeding, Agricultural University

The IVP is a department of the Agricultural University and undertakes the teaching of plant breeding to undergraduates and graduates at the University. In addition, it is involved in research on various aspects of plant breeding.

ITAL Research Institute ITAL

ITAL is an institute which has concerned itself with research on a number of fundamental and applied research areas and, in particular, it is developing new methods and techniques for plant breeding using genetic engineering techniques.

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IVT Institute for Horticultural Plant Breeding

The IVT is the principal institute concerned with the breeding of horticultural crops in The Netherlands.

LH Agricultural University, Wageningen

The Agricultural University is the principal institution concerned with tertiary education in The Netherlands.

NAA Dutch Potato Association

The NAA is a forum for considering some of the wider scientific and economic issues affecting the potato sector. Its membership includes all the important organizations and individuals with an interest in the sector.

NAK Inspection Service for Seeds and Seed Potatoes

The NAK works under the supervision of the Ministry of Agriculture and Fisheries, although it is an interprofessional organization representative of breeders, growers and users of seeds and seed potatoes, and merchants. It comprises four separate regional services and headquarters at Ede. The main object of the NAK is to establish standards and requirements and to exercise supervision and control over the firms which grow and deal in seeds and seed potatoes. The NAK is the official inspection service for seed products.

NIVAP Organization for the promotion of Dutch potatoes and potato products - seed potatoes

NIVAP is an organization which has the function of promoting Dutch arable products. It is divided into two separate sections, NIVAC which deals with ware potatoes and potato products and NIVAP which is concerned with seed potatoes. NIVAP is funded from the levy collected by the *Landbouwschap* and by the Seed Potato Wholesalers. Its function is to promote Dutch seed potatoes in export markets. Its usual strategy is to concentrate its work on those markets which are not very well developed in order to provide a starting point for the work of the private exporter.

NKB Voluntary representative organization for private breeders

The NKB is the representative organization for plant breeders in The Netherlands. It is a "free" organization without any statutory responsibilities. It is split into various sub-sections which cover the interests of the breeding of different commodities. A separate section considers the interests of potato breeders.

NRLO National Council for Agricultural Research

The NRLO is an organization concerned with the coordination of the whole of Dutch agricultural research. It is a very important organization in terms of identifying research priorities within the aegis of publicly financed agricultural research. Its role is principally that of advising the Government on the

Appendix 4. Dutch Seed Potato Sector Organizations

planning and coordination of the agricultural research sector of Dutch agriculture and, as a part of that role, it is involved in the study of agricultural research and agricultural research organizational problems and documentation of research activities.

PAGV Research station for arable farming and field production of vegetables

The PAGV is the principal research station for work on arable crops and outdoor vegetables. Its work is concerned with some of the basic problems concerning the production of arable crops and it seeks to provide field experience for the implementation of the findings of more fundamental research.

PD Plant Protection Service of the Ministry of Agriculture and Fisheries

The PD is the official plant-protection service of the Ministry of Agriculture and Fisheries. It is largely concerned with the distribution and control of plant diseases and pests and with phytosanitary inspection of seed crops.

RIVRO Government institute for research on varieties of cultivated plants

RIVRO is the official Government institute for the testing of agricultural and horticultural varieties. Tests for valuing cultivation and use and for distinctness, uniformity, and stability are conducted by RIVRO for plant breeders' rights registration, national listing and farm extension work.

RVK Board of Plant Breeders' Rights

The RVK is the Board with the responsibility for handling all matters connected with the granting of plant breeders' rights in The Netherlands.

SVP Foundation for Agricultural Plant Breeding

The SVP is the principal organization concerned with agricultural plant breeding in The Netherlands. It is concerned with the breeding of basic material which is put at the disposal of private breeders for their use. It also has a role in advising breeders. The Board of the SVP includes representatives of the Dutch breeders' union, the Industry Board for Agriculture, and the Agricultural University and the Ministry of Agriculture and Fisheries.

PCC Seed Potato Committee

The PCC is funded by levies collected from seed-potato farmers and the seed-potato trade through their respective *Bedrijfschap*. The funds are used to finance STOPA and NIVAP.

PVA Commodity Board for Potatoes

The *Produktschap* is the central body concerned with the table-, processed-, and starch-potato sector. It is funded by a levy on all table, processed, and starch potatoes and carries out statistical, market information, and representative services for the industry. It includes representation from workers and

Seed Potato Systems in Developed Countries: Canada, The Netherlands and Great Britain

employers of potato producers, merchants, processors, and retailers. It also uses some of its funds to promote NIVAC.

STOPA Seed Potato Intervention Agency

STOPA is funded by PCC and is a fund which is used to offer a market of last resort for seed potato producers and merchants. It is totally funded by the industry through the levies to the PCC.

Appendix 5. Seed Potato Certification Schemes (based on answers to the Economic Commission for Europe questionnaire)

	Canada	Netherlands	England	United Kingdom	Northern Ireland
GENERAL INFORMATION CONCERNING CLASSIFICATION					
<u>Method of selection:</u>	clonal roguing	clonal roguing	clonal roguing	clonal roguing	clonal
<u>System of classification:</u>					
classes used for Basic Seed	Foundation	S, SE, E	VTSC, SE, E	VTSC, SE, E	VTSC, SE, E
classes used for Certified Seed	(base) certified ^a	A, B, C	AA OC	AA -	A -
<u>Features considered for classification:</u>					
<i>Globodera rostochiensis</i>					
- soil analysis of field to be cropped	Not present in Canada except in quarantine areas of Newfoundland and Vancouver Island	applied	yes	yes	yes
- size of sample		200cm/0.33 ha nil	500 ml nil	500 g nil	500 ml/2 ha nil
- tolerance (number of cysts)		not applied	on suspicion nil	yes nil	- nil
- examination of roots at the time of field inspection					
- tolerance (number of cysts)					
<i>Globodera pallida</i>					
- soil analysis of field to be cropped	see above	applied	yes	yes	yes
- size of sample		250 cm/0.5 ha nil	500 ml nil	500 g nil	500 ml/2 ha nil
- tolerance (number of cysts)		not applied	on suspicion nil	yes nil ¹	- nil
- examination of roots at the time of field inspection					
- tolerance (number of cysts)					
Premature haulms destruction	obligatory	obligatory	obligatory for VTSC and SE early varieties. Requirement for E and AA crops outside protected regions dependent on virus levels. recommended	obligatory for VTSC and SE	obligatory
- basic seed					
- certified seed	obligatory	obligatory			
Examination of state of health of tuber samples before despatch (virus tests in laboratory, growing on tests in the greenhouse or field)					
- basic seed	by sample	all lots	not done	not required	no
- certified seed	by sample	all lots	not done	-	-
Inspection of tubers at despatch before closing packaging (presentation, sizing, discases, etc)					
- basic seed	all lots	all lots	all lots as many as possible	not required	no
- certified seed	all lots	all lots		-	-
Growing-on check of the progeny (trial field)					
- basic seed	by sample	not done	no	no	no
- certified seed	by sample	by sample	not done	-	-
<u>Requirements concerning isolation and rotation:</u>					
Isolation requirements: distance between seed and other potato crops					
- basic seed	60 m	not applied	50 m ^b	separate farms	50 m or depending on state of health
- certified seed	60 m	not applied	50 m		-

Seed Potato Systems in Developed Countries: Canada, The Netherlands and Great Britain

	Canada	Netherlands	England	United Kingdom	Northern Ireland
<u>Field inspection:</u>					
Applied	yes	yes	yes	yes	yes
Minimum number of official inspections					
basic seed	3	3	2 (AA:1)	2	2 - 4
certified seed	2	A=3:B=2:C=2	1	.	.
<u>DISEASES AND FAULTS CONSIDERED FOR CERTIFICATION</u>					
<u>Field inspection:</u>					
Virus disease (tolerance): severe virus, including leaf roll, virus Y or heavy mosaic					
basic seed	0.1%	0.09%	leaf roll: VTSC nil SE 0.01% severe mosaic: VTSC/SE nil other basics 0.1-0.25% combined 2%	leaf roll: VTSC nil SE 0.01% severe mosaic: VTSC/SE nil combined E-0.1% 0.25%	
certified seed	1.0% (all visible virus included in tolerances above)	0.50%			AA
Mild mosaic					
basic seed	0.09%	VTSC nil others - 0.05%-2%	VTSC nil SE 0.05% E 0.5% AA 2.0%	VTSC nil SE 0.05% E 0.5% A 1%	
certified seed	4%	5%	.	.	
Soil borne viruses					
basic seed	not occurring in Canada	0.40%	n/c	n/c	n/c
certified seed		1.30%	n/c	.	.
Other virus diseases					
	nil				TVNV nil all classes
Fungal and bacterial diseases - presence and tolerances					
<i>Synchytrium endobioticum</i> tolerance					
	Reported in Newfoundland only	Not known to occur in 10YM	Reported	Reported	Not reported
basic seed	nil	nil	nil	nil	nil
certified seed	nil	nil	nil	nil	nil
<i>Erwinia atroseptica</i> tolerance (conforms or not to UN/ECE Standards S-1):					
basic seed	conforms	nil	VTSC nil others 0.25-1.0%	(conforms) VTSC nil SE 0.25% E 0.5% AA 2.0%	yes
certified seed	conforms	conforms	2%	.	.
<i>Corynebacterium sepedonicum</i> tolerance					
	not reported	not known to occur	not reported	not reported	not reported
basic seed	nil	nil	nil	nil	nil
certified seed	nil	nil	nil	.	.
Varietal purity and type					
Rogues and variants (other varieties and aberrant plants)					
	conforms	nil (basic +0)	VTSC nil SE/E 0.05% AA 0.01% included in above	VTSC nil SE/E 0.05% AA 0.01% included in above	VTSC nil SE/E 0.05% AA 0.01% included in above
Rogues					
	conforms	nil (basic +0)			
<u>Post-harvest testing:</u>					
Application: post-harvest testing is applied					
basic seed	yes	yes	no	no	no
certified seed	yes	yes	no	.	.
Size of sample					
basic seed	400 tubers	200-600 tubers	n/a		n/a
certified seed	400 tubers	100-200 tubers			

Appendix 5. Seed Potato Certification Schemes

	Canada	Netherlands	England	United Kingdom	Northern Ireland
Virus diseases considered					
- basic seed	PSTV Mosaic leaf roll	leaf roll virus Y virus X virus S	n/a	n/a	
Sampling:					
Sampling is carried out officially					
- basic seed	yes	yes	no	yes	no
- certified seed	yes	yes	no	-	-
Stage of sampling:					
in the field					
- basic seed	yes	yes	no	no	no
- certified seed	yes	yes	no	-	-
during harvest					
- basic seed	yes	yes	no	yes	no
- certified seed	yes	no	-	-	-
in the box or bag					
- basic seed	yes	yes	no	yes	no
- certified seed	yes	yes	no	-	-
other					
- basic seed		yes			
- certified seed		yes			
Inspection of tubers at despatch					
before closing:					
Size					
- tubers larger than maximum size	5%	conforms	3%	3%	1.5%
- tubers smaller than minimum size	3%	conforms	3%	3%	1.5%
Mechanical defects and physical faults:					
- (*) blemishes, malformations and cracks - tolerance	2%	allowed	3%	3%	0.5%
- earth and extraneous matter - tolerance	conforms	allowed	1%	1%	1%
Tuber diseases (tolerance):					
- <i>Synchytrium endobioticum</i>	nil	nil	nil	nil	nil
- <i>Pseudomonas solanacearum</i>	nil	nil	nil	nil	nil
- <i>Corynebacterium sepedonicum</i>	nil	nil	nil	nil	nil
- (*) other wet and dry rots	1%	conforms	1%	1%	1%
- (*) <i>A. eptomyces scabies</i>	5% moderate	conforms	VTSC 3%	conforms 4% (0.25 surface area)	10%
- <i>Spongospora subterranea</i>	conforms	basic seed nil Cert seed free	VTSC 1.5% others 4% (0.25 surface area)	4% (0.25 surface area)	(1/10 infection)
Total tolerance for the three items marked with an asterisk (*) in relation to the Geneva Standard (UN/ECE)	6.1%	conforms	VTSC 4% others 5%	conforms 5%	11.5% (surface is different to standard)
Pests					
- <i>Globodera rostochiensis</i>					
presence	not reported	reported	reported	reported	reported
tolerance	except in quarantine areas of Newfoundland and Vancouver Is.	nil	nil	nil	nil
- <i>Globodera pallida</i>					
presence	not reported	reported	reported	reported	reported
tolerance	nil	nil	nil	nil	nil
- <i>Diitylenchus destructor</i>					
presence	not reported	nil	nil	nil	not reported
tolerance	not prescribed	allowed	voluntary	allowed	TBZ and MBC
Chemical treatment of tubers:					
Fungicidal disinfectants (eg against rhizoctonia or common scab)	not prescribed	allowed	voluntary	allowed	TBZ and MBC
Other chemical treatments	not prescribed	allowed (against <i>Fusarium</i> and scab)	not required	nil	
Lossing of packages and despatch:					
Official system of closing carried out by:					
- an inspector of the authority in charge of certification	no	yes	no	no	yes

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	Canada	Netherlands	England	United Kingdom	Northern Ireland
a third party under the supervision of an inspector or the responsible authority	no	no	no	no	no
the producer or a commercial firm	yes	no	yes (sample checked by inspector)	yes	no
other systems of closing	no	no	no	no	no
Certificates, labels and seals					
Each package is supplied with:					
a certificate inside	yes	no	document (if required)	no	yes
a label outside	yes	yes	yes	yes	yes
a seal	yes	yes ^c	yes (for tie on labels only)	yes (for tie on labels only)	yes
other systems of closing	no	no	machine stitching	machine stitching	machine stitching
Color of label and certificate					
Basic seed					
label	white	not applied	white	white	white
certificate	white	white	-	-	white
Certified seed					
labels	blue	not applied	blue	-	-
certificate	white	blue	-	-	-
Particulars stated on label and certificate					
Nature of contents (seed potatoes)					
basic seed	label/certificate	certificate	label/certificate	label	label/certificate
certified seed	-	certificate	label/certificate	-	-
Certifying body and producing country					
basic seed	label/certificate	certificate	label	label	label/certificate
certified seed	-	certificate	label	-	-
Producer's identification number or reference number of the lot					
basic seed	label/certificate	certificate	label/certificate	label	label/certificate
certified seed	-	certificate	label/certificate	-	-
Variety					
basic seed	label/certificate	certificate	label/certificate	label	label/certificate
certified seed	-	certificate	label/certificate	-	-
Country and/or region of production					
basic seed	label/certificate	certificate	label	label	label/certificate
certified seed	-	certificate	label	-	-
Category and class					
basic seed	label/certificate	-	-	-	-
certified seed	-	-	-	-	-
Size					
basic seed	label	certificate	label/certificate	label	label/certificate
certified seed	label	certificate	label/certificate	-	-
Declared net weight					
basic seed	label	certificate	label	label	label/certificate
certified seed	label	certificate	label	-	-
Crop year					
basic seed	label/certificate	certificate	label	label/	certificate
certified seed	-	certificate	label	-	-
Date of closing					
basic seed	label	certificate	label	-	label/certificate
certified seed	label	certificate	label	-	label/certificate
Other particulars					
			chemical treatment (if any)	-	chemical treatment (if any)

^a Elite I, II, III (for pre-basic seed).

^b For pathogen tested scheme.

^c On hand closing only.

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