CONFERENCE PAPERS

The Potato in the Food Business – Past to Present

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INTRODUCTION: - GLOBAL PATTERN

Over the past three decades, potato production according to FAO (United Nations Food and Agriculture Organisation) has grown faster than any other food crop except wheat. Areas of the world which in the past were minor consumers of the crop, are turning to reduce their dependence on traditional crops and to diversify production systems built on mono cropped cereals.

Agriculturally, no other crop in the eyes of developing countries has more production potential. While major cereals are fast approaching the limits of their production potential, the yield potential of the potato is still largely underexploited even in some industrialised countries. Furthermore, in developing countries, the potato is seen as a logical candidate to solve domestic food problems. Over a billion people, half of whom live in the developing world now eat potato. In terms of nutrition, as little as 100 gms. supplies about 10% of the recommended daily allowance of protein for children – an important consideration for countries seeking to improve the diets of people at risk from malnutrition. One hundred grams of potato also supplies the equivalent of 10% of an adults need for thiamin, niocin, vitamin B6 and folic acid and 50% of their vitamin C requirement.

Since the early 1960's global production until the early nineties remained at about 270 million tonnes. In recent years (e.g. 1998) this has risen to about 290 million tonnes with about 1/3 of this production taking place in development countries. This compares with just over 10 per cent of global production in the early 1960's and 19 per cent in the mid 1970's. In summary therefore, overall world potato production shows an upward trend, with more production-taking place in developing countries. Consequently, potato developments in the E.U. have to be viewed again this background. (See Table 1 – World Potato Production. Source: Food and Agriculture Organisation of the United Nations (FAO).

EARLY HISTORY – FOOD AND DRINK IN SOUTH AMERICA

It is now generally accepted that wild potatoes grew on the Chilean coast as early as thirteen thousand years ago – an era before any human agriculture. The profusion of wild species on the central Andean Highlands suggests that the plant travelled upland soon afterward. In any case, as early as eight thousand years ago, it is a matter of record that Andean people farmed potatoes. (There is also evidence for the cultivation of beans and squashes nearly 10,000 years ago). Thus, several species of food plants were available at an early stage of agriculture in the Central Andean Zone of what are new Peru and Bolivia.

This area is now considered to be one of the four world nuclear centres of agricultural origins. Keeping and cooking food were obviously difficult and frost could ruin anything in storage. However, the highland peoples manufactured a freeze-dried preparation called *chuno* which is still in use today. The potatoes were

spread on the ground and left there at night to freeze. The following day the tubers were treaded with bare feet to squeeze out the water. This procedure was repeated over four or five consecutive days and at the end of the period the *chuno* was dried off and stored. When required, the *chuno* softened rapidly in boiling water and was quickly ready to eat and could be used in stews etc. Throughout the ages *chuno* was as important in that region as bread was elsewhere.

As a testament to man's ingenuity even in the earliest times the native brewed a drink (chicha – a beer), from the potato. This was no temperance beverage and is still today consumed on public occasions in great quantities. Again, in some parts of the Peruvian Sierra, they distil a most potent drink from the potato called *Chakta.*

EARLY HISTORY IN EUROPE

> *"The potato is rightly reproached for causing gas; but what are winds to the robust bodily organs of peasants and labourers ?"*. (Denis Diderot)

It is thought that the potato reached Europe in the hands of returning Spanish explorers around 1570. The first recorded usage of the potato is at the Sangre Hospital in Seville in 1573. However, much confusion surrounds its early years in Europe as around the same time the sweet potato (yam) was also introduced. Spain in particular initially favoured the sweet potato over the Andean potato for social reasons. By about 1600, the potato had entered Spain, Italy, Austria, Belgium, Holland, France, Switzerland, England and Germany, Portugal and Ireland. However, it was not grown on a field scale – but only in gardens. Indeed, many of these early gardeners were botanists employed by nobles or wealthy patrons. The spread in Europe owes its distribution to these early botanists who exchanged and stored tubers. While these botanists found the plant intriguing, the general population, initially refused point blank to adopt it as a food item. In 1596, the Swiss botanist Gaspond Baukin named the plant Solanum tuberosum – this had frightening implications solidly linking the potato to the family solanaceae i.e. the nightshades where members include the tomato, eggplant, sweet pepper, aubergine, deadly nightshade, tobacco and henbane. The name Solanum is believed to derive from the Latin solamen or "Quieting". If so, the meaning was appropriate as the potato's relations were poisons and narcotics. Furthermore, the potato belonged to the root vegetables, a group which was viewed with strong suspicion by the general populace in 16th and 17th century Europe. Many herbalists considered that root vegetables "provoked lust" – the radish, onion, leek, the skirret (which resembled a carrot) the turnip, the parsnip and the sweet potato were all given this ability). Among the general population such food was said to cause headaches and dull the senses. This was because the plant polluted the body. They increased

the "evil blood" – this was significant because fevers and infectious diseases were thought to result from inflamed blood. If roots corrupted blood it was only logical to say they spread infectious disease. As if the above wasn't enough to condemn the potato, around 1620, a rumour arose in France and England that potatoes caused leprosy. Thus the potato, tainted by affliction was fast becoming a leper itself.

By the mid-eighteenth century on mainland Europe, the potato was far from being used widely. De Combes described it in "*School for the kitchen garden*" in 1749 – and

listed many ways to cook it. Peasant people according to De Combes roasted potatoes in the embers and ate them with salt. The nobility on the other hand ate them sliced thinly, powdered with flour and fired in butter and oil – the chips ancestor.

When a famine struck Naples in 1770, people refused to touch a boatload of potatoes sent as a gift. In Prussia people feared the tubers caused rickets and tubercolosis – but were ordered to grow them by Frederick the Great as a safeguard against famine. However, in France, it was due to the effect of army pharmacist, Parmentier, that the potato came into general use. Having been taken prisoner by the Prussians in the Seven Years War (1756 – 63) he survived on potatoes and became convinced of their worth as a food. However, it was during the Napoleonic wars that the potato really came into it's own. In 1806 an economic embargo was declared on Britain. Its policy not only failed but also provoked a counter blockade which was successful. As a result, potato production in France rose sharply – food production being politically vital.

IRELAND 1845

> "*A blight of unusual character, which almost universally affects the potatoes in this island, have been the last few days, repeatedly brought to the notice of several gardeners*". (Gardeners Chronicle August 1845).

On the eve of the famine, Ireland was a country of considerable social and economic diversity both between social groups and regions. An image of Ireland as a poor backward potato based country only partially represents its pre-famine economy. Irish agriculture was more commercialised than previously has been depicted. By the 1840's, 3/5 of all agricultural output ended up in the market place. Following the end of the Napoleonic wars in 1815, there was a marked increase in the export of grain from Ireland to Britain facilitated by the existence of Protectionist Corn Laws. Britain at this stage was a net importer of corn and Ireland her largest single supplier. On the eve of the famine, an estimated two million people in addition were fed by food imported from Ireland. Consequently, at that time Ireland was rightfully described as a granary for the remainder of the United Kingdom.

How the potato came to be introduced into Ireland is not precisely known, though popular myth credits its introduction at Youghal, Co. Cork by Sir Walter Raleigh. Initially it was used as a supplementary vegetable by all social groups. In the poorest section of society however, it gradually replaced other foodstuffs and together with skimmed milk

or buttermilk became the main component of their daily diet. Its popularity was such that 10 – 12 lbs./day was the average consumption for an adult male. In 1845 2,516,000 acres, were tilled with potatoes. This fell to just over one million acres in 1846 and to a much-reduced 248,000 acres in 1847. (*This Great Calamity* – Christine Kinealy).

POTATO PRODUCTION IN EUROPE – 1990s

E.U. production today runs at 45 million tonnes and is still dominated by four countries – Germany (11.3 million tonnes), U.K. (6.6 million tonnes), France (6.5 million tonnes), and the Netherlands (6.0 million tonnes). Spain and Italy follow with 3.2 million and 2.3 million tonnes respectively. Ireland, Finland and Austria are close together producing in the region of 600,000 tonnes each.

In consumption terms, Ireland is still credited with the highest consumption of potatoes i.e. 140 kg per capita, followed closely by Portugal at 130 kg. The U.K., Greece and Belgium follow closely at around 100 kg per capita.

Outside the EU 15, but still within Europe, it is worth noting that Poland produces 26 million tonnes – more than 50% of total E.U. production. Other notable producers in Europe are Russia (31 million tonnes), Ukraine (17.3 million tonnes) Belorussia (10 million tonnes). The Czech Republic and Hungary produce 1.5 million and 1.0 million tonnes respectively. The production figures for European countries outside the EU 15 take on an increased importance when viewed again proposed EU membership.

At the time of writing (22.01.2000) the 1999 Bord Glas Census on potatoes has just been published. The 1999 figures show a very slight decrease in area from 39,000 acres to 38,700 acres. Kerr's Pink is still the number one variety at 11,274 acres (up 13%) with Rooster second at 7,558 (up 9% on 1998). Saxon increased significantly from 273 acres to 722 in 1999 (up 62%). Home Guard and Pentland Dell acreages fell significantly. The top six production counties, Meath, Dublin, Louth, Donegal, Cork and Wexford now represent 84% of the total production area. In the five years 1995-1999 the number of growers has declined by 600 from 1670 to 1076.

In the U.K. the top five varieties in order of preference are Maris Piper, Estima, Cara, Pentland Dell and Saturna. A notable feature has been the drop in Record from 14,000 hectares to less than 3,000 over the past five years. Again, as in Ireland there has been a steady decline in the number of producers from 25,000 in the mid-eighties to less than 10,000 currently.

FOOD MARKET IN THE 1990'S – A CHANGING ECONOMY, A CHANGING MARKET

As a food commodity, the potato must be looked at in the context of the overall food market. (See Table 3) The food market in turn is affected by the state of the national economy. During the 1990's Ireland has experienced a consumer boom which has not been seen before. Furthermore, at the turn of the millennium, this boom has gathered pace. In the seven year period 1993 – 1998 the volume of consumer spending increased

at an annual average rate of 5.8%. In 1998, this rose to 7.4%. This consumer boom has been powered by the rapid growth of aggregate personal incomes during the 1990's. At a national level, Irish personal incomes rose by nearly £20 billion. This incredible increase is due firstly to the increased numbers of income earners – between 1990 and Spring 1999 total employment in Ireland increased by 431,000 – and secondly, the rate of pay increase earned by those at work has also increased income growth. Gross average weekly earnings increased by about one-third.

From 1990 to 1998 total personal incomes increased from £24 billion to £43.5 billion respectively. In disposable income terms the increase was from £19 billion in 1990 to £35 billion in 1998 i.e. in 1998, after personal taxation, income earners had on a national basis £35 billion to spend.

Table 3 shows that consumer purchases of food, drink and tobacco, increased from £5.7 billion in 1990 to nearly £9 billion in 1998. This represents an increase of 55% in the period. However, it is important to note that in absolute terms, while overall spending on food has increased, as a proportion of total income, food spending has fallen. Whereas in 1980 the proportion spent on food was 25%, in 1998 this had slipped to 14%. Again, this has to be looked at against the background that – until 1995 the largest single slice of the household budget was spent on food.

DEMOGRAPHIC & LABOUR MARKET AND FACTORS AFFECTING DEMAND

1) Ireland's population is again growing – reaching 3.745 million at April 1999, a post-independence peak. Between 1990 and 1999 the population increased by 239,000.
2) The population of working age 15-64 is rising much more rapidly. Between 1990 – 1999 the proportion of working age rose from 2.15 million to 2.5 million – a 16% increase. The working age population has increased more than twice as fast.
3) The number of private households in the country increased from 1.06 million to 1.2 million - a 12.3% increase. Furthermore, households are becoming smaller. In 1997, 270,000 households had just one member while 558,000 or 46% of the total had two or fewer members.
4) The significant increases in employment in the 1990's but particularly by increased labour force participation amongst women.
5) Finally, net emigration has been replaced by net immigration.

THE POTATO AND OTHER FOOD ITEMS IN THE MARKETPLACE

Again, as a food commodity one has to deal with potato consumption against the background of major changes which are taking place in the overall food market. Increased travel, changing lifestyles, a stronger economy, changing demographics and more women at work are just some of the factors affecting food purchases. According to the Irish Bottled Water Association, we now spend £60 million on bottled mineral water – a

remarkable figure given our rainfall statistics. On pastas, pizzas and rice (direct competitor products of the potato) we are now spending £75 million. Credited as being the highest potato consumers, the Irish are the highest consumers of tea in the world (3.2 kg/capita). After Denmark and Belgium, Ireland comes third in the European league tables for both chocolate and sugar confectionery. We also come third place in Europe for ice-cream consumption. Taking wine as an example of a commodity affected by the factors referred to earlier, we see the following: Since 1990 the Irish wine market has grown by 95.3% in volume (now at 7.5 litres per capita as against France 60.0 litres per capita) In 1993 80% of wine sales in Ireland were at £4.99 or less. By 1997, only 45% of sales were at this price. A lot more younger people are drinking wine and these younger people are replacing older non-wine drinkers in the market. These younger people are also our potato consumers, and we have to present the potato to these consumers in an imaginative and sophisticated convenient manner.

Steady growth is also being experienced in the frozen food sector (where the potato is getting its share). Growth is also strong in confectionery, snack food and other sectors. (The growth in adult snack foods has been phenomenal). Such snacking 'grazing' etc. has to be having a displacement effect on staples. Table 4 shows spending on some food items. Significantly, the home baking sector (value £15 million) was the only sector seen to be experiencing little or no growth.

THE TIME POOR - A NEW MARKET

In many countries, cooking has become a spectator sport i.e. something one watches other people do on television. In the U.S. and U.K. these people are known as the "time poor" – people who can't or haven't the time to cook. This has led to a concept called the "grocerant" which is currently sweeping the U.S. The local supermarket or grocery store employ chefs to cook anything from Beef Wellington to Salmon *en Croute* and these dishes are supplied in smart disposable plastic tableware. Are we going to reach the stage where breakfast, lunch and dinner are going to be purchased across the counter or taken in a restaurant ? Convenience is King and whatever way the market goes, it is up to the potato industry to have its product represented at point of sale.

CONCLUSION

Supply Side: Overall world potato production is increasing. Potato production in most countries set to join the EU in the next decade is significant. Within the EU itself there is no sign in the short term, of any common organisation of the market. The ware potato in the E U now trades in a single market. In round figures, Ireland produces ½ million tonnes as against 45-50 million tonnes (depending on the year) total EU production. Hence a 1% increase in E U production is equivalent to the total level of Irish production.

Demand Side: The food market in general has undergone a period of significant change and as a food commodity these changes are impacting on potato purchases. Continued population expansion will underpin growth in the food and drink sectors.

Food safety is of supreme importance – food must not only be safe but be seen to be safe. There is steady growth in organic food consumption in the UK. Rapid rates of household formation amongst households containing only one or two members, rising labour force participation rates amongst women (particularly married women) have given rise to a new poor, the "time poor" whereby the convenience element is vitally important. Rising incomes and increased immigration will lead to a wider product range and more sophisticated tastes. Furthermore, rising employment and higher household incomes will increase the opportunity cost of leisure time. Consequently, households are likely to allocate less time to preparation and consumption of needs within the house and more time and income to eating out.

In the potato business we have a product that has served mankind well for over 3000 years. The potato has an incredible tradition, is nutritious and wholesome, and can be presented in an imaginative, sophisticated and convenient manner and can match the demanding requirements of the 21st century consumer.

TABLE 1
TOP TEN WORLD PRODUCTION 1998

Country	*Production (Million tonnes)*
China	48 million
E.U. 15	45 million
Russia	37 million
Poland	26 million
U.S.A.	21 million
India	19 million
Ukraine	17.5 million
Belarus	10 million
Turkey	5.3 million
Canada	4 million

Source: Food and Agriculture Organisation of the United Nations (FAO).

TABLE 2

E.U. POTATO PRODUCTION 1998

Country	*Production (Million tonnes)*
Germany	11.3 million
U.K.	6.6 million
France	6.5 million
Netherlands	6.0 million
Spain	3.2 million
Belgium/Luxembourg	2.8 million
Italy	2.3 million
Sweden	1.6 million
Denmark	1.5 million
Portugal	1.3 million
Greece	0.8 million
Finland	0.7 million
Austria	0.65 million
Ireland	0.6 million

Source: Food and Agriculture Organisation of the United Nations (FAO).

TABLE 3

TRENDS IN CONSUMER SPENDING £million

Product	*1990*	*1995*	*1997*	*1998*
Food	3,119	3,608	3,998	4,282
Non-alcoholic drink	212	235	323	414
Alcoholic drink	1,799	2,465	2,989	3,191
Tobacco	608	908	974	1,043
Food, drink, tobacco	**5,738**	**7,216**	**8,284**	**8,931**

TABLE 4

FOOD SPENDING (1998)

ITEM	*£*
Beer	£2 billion
Tobacco	£1 billion
Soft drinks	£400 million
Confectionery	£350 million
Wine	£320 million
Fruit and vegetables	£180 million
Frozen food	£200 million
Milk	£170 million
Biscuits	£130 million
Snack foods	£120 million
Ice cream	£100 million
Cheese	£64 million
Bottled water	£60 million
Tea	£50 million
Coffee	£30 million
Home baking	£15 million

Source: Checkout

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Selecting the Right Variety

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The choice of variety is of major importance in potato growing as it affects the yield, quality, storability and ultimate use of the produce.

The selection of varieties for processing is determined by the processor usually by contract with the grower. For the fresh market grower must consider consumer, merchant and supermarket requirements as well as agronomic characteristics when deciding the range of varieties to grow.

CONSUMER REQUIREMENTS

A number of consumer surveys were carried out over the last twenty years. The 1983 survey (Cowan et al) showed that 58% of those interviewed preferred a dry "floury" potato, while 14% like a firm moist potato and 27% an intermediate type. A similar survey by Bord Glas in 1991 indicated 39% preferred a "floury" type, 18% a firm moist potato and 39% an intermediate type. This showed a reduction in acceptability of "floury" potatoes and an increase in intermediate quality and firm moist potatoes.

The earlier survey also showed 56% preferred red skinned varieties, 47% preferred white fleshed potatoes and 90% of respondents served boiled potatoes with more than half pre-peeling before boiling. It would be very interesting to see how consumer preferences have changed since 1991 with the marked swing to washed potatoes and the greater range of quality types on the supermarket shelves.

The extent of complaint received about the eating quality of potatoes available at supermarket level would indicate that more concern should be given to this aspect of overall quality.

SUPERMARKET REQUIREMENTS

Supermarkets have a major influence on the varieties, range and quality of potatoes offered to the consumer. They tend to place major emphasis on cosmetic appearance with much less emphasis on eating quality. They have a major influence on the enormous change to washed potatoes over the last few years. They now offer the consumer a much wider range of varieties from punnet and salad types to the traditional varieties like Kerrs' Pink and Golden Wonder.

CHANGES IN VARIETIES GROWN IN IRELAND FROM 1991 - 1999

The main changes in the varieties grown over the last nine years since An Bord Glas surveys began has been the steady increase in area of Rooster, a red-skinned maincrop variety bred by Teagasc. It has increased from 29.5ha in 1991 or 0.2% of the potato area

to 3061ha or 19.5% of the area in 1999 as shown in the following Table 1 and Fig. 1.

Table 1: Area of Rooster in Republic of Ireland 1991 - 1999

Year	*Area*	*% of total potato area*	
	Ha	*acres*	
1991	29.5	73	0.2
1992	132.0	326	0.8
1993	310.5	745	1.9
1994	608.3	1503	3.6
1995	1058.3	2922	6.6
1996	2206.8	5453	12.2
1997	2081.3	5143	13.6
1998	2790.0	6894	17.6
1999	3061.0	7558	19.5

Source: An Bord Glas National Potato Census 1991 - 1999

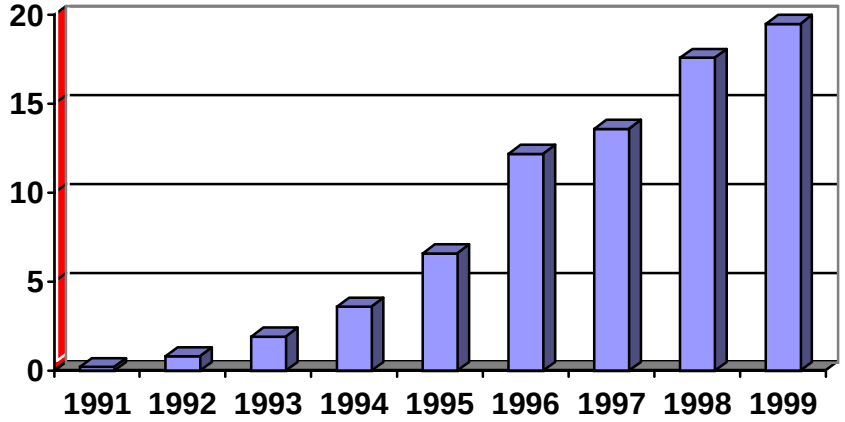


Fig. 1: Rooster % Total Potato Area 1991- 1999

The percentage of the total potato area occupied by the main varieties grown in Ireland from 1991-1999 is given in Table 2 and Fig. 2. These show that the Kerrs' Pink area has remained very stable, while the Rooster portion has increased steadily to 19.5% in 1999. The area under Records has decreased from 25.5% in 1991 to 11% in 1999 due partly to its replacement by Saturna and Lady Rosetta for crisp processing. These latter varieties having 6.0% and 4.0% of the area in 1999. Pentland Dell has reduced from 5.9% in 1991 to 1.0% in 1999 probably due to the increase in Rooster.

The area under British Queen, Home Guard, Golden Wonder, Cara and King Edward has also reduced to varying degrees. The Home Guard being affected by imports of set skin potatoes from Mediterranean countries. The increase in second early Saxon to 2.0% in 1999 is due to its excellent appearance but it eating quality is very mediocre and not comparable to British Queen. Irish growers will increasingly have to compete with cheaper, good appearance varieties of mediocre to poor eating quality imported from the U.K. etc. Growers must improve the appearance of potatoes offered for sale, while maintaining good eating quality to compete effectively with more imports.

Table 2: Major potato varieties grown in Ireland 1991 - 1999

Variety	*Percentage of total potato area*				
	1991	1994	1996	1998	1999
Kerrs' Pink	29.0	32.0	22.7	25.0	29.0
Record	25.5	23.5	15.7	13.0	11.0
British Queen	13.3	12.5	11.7	9.0	10.0
Golden Wonder	8.7	6.2	5.5	5.0	5.0
Pentland Dell	5.9	4.9	5.8	2.0	1.0
Home Guard	5.0	4.5	4.2	4.0	2.5
Cara	4.8	2.1	2.5	1.0	1.5
Maris Piper	2.2	2.3	3.9	5.0	5.0
King Edward	1.3	0.6	0.9	0.05	0.05
Rooster	0.2	3.6	12.2	17.5	19.5
Saturna	-	2.5	4.8	7.0	6.0
Lady Rosetta	-	0.2	0.7	3.0	4.0
Saxon	-	-	-	1.0	2.0
Fianna	-	-	-	1.3	0.2

Source: An Bord Glas national Potato Census 1991 - 1999

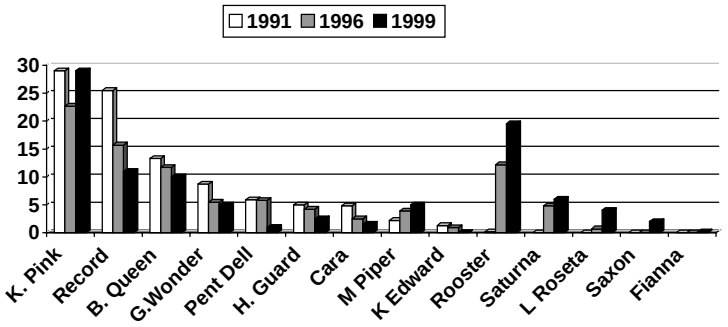


Fig. 2: % total area of main varieties 1991 - 1999

VARIETY MATURITY, DATE OF PLANTING AND EARLY HARVESTING

The market requirements will largely determine the varieties to be grown and it is important that this selection gives a range of maturity types to enable harvesting to start as early as possible so that it is completed before soil conditions deteriorate. Early planting under good soil conditions is also very important to achieve acceptable eating quality and earlier harvesting. However, many growers tend to plant more potatoes than they can handle and harvest late under difficult conditions in most years. These growers should curtail the area grown to what they can harvest before the end of October under average weather conditions especially if the potatoes are for long-term storage, washing or pre-packing.

VARIETY EVALUATION

Variety evaluation is carried out by the Department of Agriculture and Food from their variety-testing centre at Backweston. They evaluate new potato varieties for entry to the Irish National List and carry out recommended list trials on promising new varieties from Ireland and other countries. They issue a recommended list of potato varieties each year. The charts giving the recommended and other varieties for both early, second early and maincrop varieties in 1998 are given in Appendix 1. These are based on the assumption that Irish consumers prefer high dry matter floury varieties.

The following is a short summary of the recommendation for each maturity group:-

First earlies

Home Guard is the only variety recommended; while the other varieties are Colleen, Orla and Rocket. Colleen is the nearest to Home Guard on consumer quality and is rated 100 on marketable yield compared to 87 for Home Guard. While Orla rated 110 is slightly inferior on eating quality to Colleen. Rocket rated 120 is rated the highest on yield but is the least acceptable on eating quality and is very subject to growth cracks in some years.

VARIETIES UNDER TEST 1999

Home Guard, Rocket, Orla, Roscor and Seedling T491/3.

Second Earlies

British Queen (109) is the only recommended variety due to its excellent eating quality.

VARIETIES UNDER TEST 1999

Nadine, Saxon, British Queen.

Maincrops

Four varieties are recommended, Kerrs' Pink (89), Pentland Dell (100), Record (88) and Rooster (102) as all are rated good to very good on eating quality. The other varieties

given include Brodick, Cara, Fianna, Maris Piper, Navan, Panda, Saturna and Van Gogh are all rated acceptable to good on eating quality. Brodick, Panda, Saturna and Rooster are very acceptable on crisp colour.

VARIETIES UNDER TEST 1999

Hermes, Malin, Chieftain, Maris Piper and nine Teagasc bred seedlings as National and Recommended list trials have been combined in recent years.

BREEDING NEW VARIETIES

Teagasc have been breeding new varieties for all aspects of the potato trade at Oak Park Research Centre, Carlow since 1962.

A major part of the programme is aimed at breeding improved varieties for the seed export trade particularly to the Mediterranean region and England. This work is supported financially by Irish Potato Marketing Ltd.

The breeding of high yielding disease resistant good quality red skinned early maincrop and maincrop types suitable for the home ware trade is still an important objective, while the selection of more suitable varieties for processing is tied closely to this aim.

BREEDING AND EVALUATION PROCESS

Each year around 80,000 seedlings are raised from true seed at Oak Park and evaluated over a period of 10 - 12 years in trials in the main potato growing districts in Ireland. Seedlings are also selected at an early stage for initial evaluation in England and in the Mediterranean region in order to exploit the potential of the programme to the maximum. Seedlings found promising in these initial trials over a few years are included in trials by State Agencies and importers in the various countries.

At the end of the evaluation process, one or more seedlings may remain, which are superior to existing varieties in Ireland or some of the seed importing countries, in one or more important characteristics. Once a seedling is named and place on the Irish National List and has obtained Plant Variety Rights, commercial seed multiplication can commence. It takes about fifteen years for the making of the initial cross until a new variety will be commercially available to a potato grower whether in Ireland, England or in the Mediterranean region.

PROGRESS TO DATE

Twenty-one varieties have been named and commercially released from the programme to date. Sixteen of these are still in commercial production. Cara has been the most successful of these varieties occupying 9-10% of the maincrop area in Great Britain in the last four years. It is also an important seed export variety to Egypt, Canary Islands, Cyprus, Spain, Portugal, Azores and Malta. Burren and Slaney are important seed export varieties, while Ambo, Avondale, Red Cara, Druid and Barna tend have specific markets. Anna, Ambo and Barna are also grown in England. Rooster has gained 19.5% of the

potato area in the Republic of Ireland and is now the second most important variety grown. Orla and Shannon are in the early stages of commercial development. Colleen at 0.41% of the potato area in 1999 has not been accepted as a serious competitor to Home Guard even though it is the most acceptable alternative on eating quality and is higher yielding and more drought resistant.

Two seed export varieties have recently been named and should be national listed shortly. One of these Malin is aimed at the English pre-packing trade while the other T52/65 with the proposed name Banba is an early maincrop with a potential for the Mediterranean market. Both are being assessed at farm level in these markets in 2000. Seedling T491/3 a first early will shortly be named. It has completed official tests. It seems to have a potential as an early "baker" in England and for early areas of the Mediterranean. Its eating quality, dry matter content and marketable yield are very similar to Orla as the main results of the Department of Agriculture and Food first early variety trials 1996-1999 given in Table 3 show. Both are slightly better on eating quality to Rocket but not as good as Colleen.

Table 3: Mean results of Department of Agriculture and Food 'first early' potato variety trials, 1996 - 1999

Centres: Cork, Dublin and Wexford

Seedling or variety	*Marketable yield*	*% Dry matter*	**Discolouration*	**Overall eating*	**Crisp quality quality*	
	% of Home Guard		*After cooking*	*After 24 hours*		
First lifting						
Colleen	119	19.42	9.0	8.4	5.0	5.7
Home Guard	100	20.18	7.8	5.9	4.9	6.3
Orla	129	17.29	8.9	8.9	4.2	5.2
Rocket	141	17.32	7.9	7.4	4.1	4.7
Roscor[1]	113	16.42	8.2	6.7	4.1	5.5
T491/3[1]	127	17.58	9.0	8.3	4.4	5.0
Second lifting						
Colleen	122	20.00	9.0	8.5	5.2	5.8
Home Guard	100	20.79	8.3	6.4	5.3	5.9
Orla	137	18.28	8.9	8.9	4.8	5.4
Rocket	140	17.85	8.0	6.8	4.2	4.7
Roscor[1]	120	17.05	8.7	7.2	4.4	5.7
T491/3[1]	134	17.94	9.0	7.7	4.7	5.0

*9 = most desirable or best [1] = variety not included in 1996 trials

Source: Department of Agriculture and Food (Quality evaluation by Teagasc)

A number of advanced seedlings have completed or are undergoing D.U.S. and National List tests. They are all aimed at the seed export trade and will be considered for naming once commercial assessment trials are carried out at farm level in these countries. They include earlier alternatives to Cara, red skinned alternatives to Desiree and a high yielding alternative to Spunta and Burren as well as a number of seedlings showing potential for the English market. For the home market three red skinned seedlings and one parti-coloured type are being evaluated for the home ware trade or processing due to their good eating quality. The results of trials to date comparing these seedlings with Kerrs' Pink, Rooster and Cara are given in Table 4. All four seedlings are higher yielding than Rooster except in the 45-60mm grade, while the Cara type seedling T1903/19 is similar on yield to Cara but is much better on eating quality and has a mean dry matter content of 22% compared to Cara at 19.4%.

Seedling T1823/10 and T1851/8 are both deep red skinned types and are very similar to Rooster on eating quality and dry matter content. Seedling T1823/10 gave a much better crisp colour than Rooster or the other seedlings and will be evaluated at factory level next year. Its skin tends to be russety and sometimes netted which would limit its suitability for the ware trade and possibly for processing. Seedling T1851/8, a maincrop would seem to be the most promising on appearance for pre-packing, while seedling T1945/1, a pinky red early maincrop also has good appearance but its eating quality and dry matter content is lower than T1851/8.

Table 4: Teagasc Potato Breeding Programme

Comparison of four seedlings with Rooster, Kerrs' Pink and Cara in six Teagasc maincrop evaluation trails 19

Centre: Carlow, Meath, Louth and Wicklow

Variety or seedling	Yield as % Rooster				Total yield			C
	45-60 mm	45-80 mm	50-80 mm	45-85 mm	clean yield	*discoloration		
						after cooking	after 24 hrs.	
T1823/10	78.6	102.3	109.2	104.1	101.8	99.4	9.0	6.8
T1851/8	82.0	103.1	107.7	105.3	103.8	112.3	8.7	8.4
T1903/19	71.2	115.4	124.1	118.0	118.1	114.9	8.8	7.9
T1945/1	80.2	109.0	113.1	112.0	114.7	111.9	8.9	7.9
Kerr's Pink	73.0	80.8	81.1	82.1	87.8	87.8	9.0	9.0
Cara	64.8	115.9	125.2	119.6	119.3	116.2	9.0	8.1
Rooster	100.0 (2515 t/ha)	100.0 (50.2 t/ha)	100.0 (43.8 t/ha)	100.0 (50.9 t/ha)	100.0 (55.1 t/ha)	100.0 (58.6 t/ha)	9.0	8.8

*9 = most desirable

There are a number of white fleshed red skinned maincrop types with good eating quality and these will be closely monitored as alternatives to Kerrs' Pink over the next few years. A seedling with a potential for the "punnet" type market is also being evaluated at present.

CONCLUSIONS

The selection of a good quality white fleshed alternative to Kerrs' Pink is a major priority of the breeding programme over the next few years. Such a variety if suitable for processing might compete effectively with Maris Piper for the fresh chip trade. Rooster which produces good quality chips is at present not accepted for this market due to its yellow flesh. Although it is used for the production of frozen chips in Ireland. Concentrating on good eating quality varieties and using new improved varieties will help growers compete with imports in the future.

APPENDIX 1

Irish Potato Variety Evaluation Results including the recommended list of varieties 1998. Published by Department of Agriculture and Food.

Early Potato Varieties

	First early varieties				Second early varieties
	Recommended	Other Varieties			Recommended
Agronomic and quality characteristics	**Home Guard**	**Colleen**	**Orla**	**Rocket**	**British Queen**
Marketable yield %*	87	100	110	120	109
Tuber shape	3	4	6	3	5
Eye depth	5	6	7	6	7
Flesh colour	2	5	5	2	2
Skin colour	w	cy	w	w	w
Eating quality**	5.3	5.0	4.5	4.1	6.9
Dry matter %	22.0	21.0	19.3	19.3	23.3
Crisp colour	6.6	5.9	5.8	5.1	7.4
Disintegration	3.4	3.8	3.0	1.9	5.6
24 hr. discolouration	5.8	8.4	8.9	7.1	8.3

*Marketable yield is yield of ware greater than 40mm in size (Colleen=100.)

**Eating quality scores based on the assumption of a preference for high dry matter floury varieties

Maincrop Potato Varieties

	Recommended				Other Varieties				
Agronomic and quality characteristics	**K. Pink**	**P. Dell**	**Record**	**Rooster**	**Brodick**	**Cara**	**Fianna**	**M. Piper**	**Navan (p)**
Marketable yield %*	89	100	88	102	101	102	98	103	101
Foliage Maturity	3	5	8	5	6	3	3	4	4
Common Scab	5	5	7	8	5	7	5	3	5
Foliage blight	5	6	5	4	8	7	6	5	6
Tuber shape	3	7	4	5	4	3	6	4	4
Eye depth	4	7	5	7	8	6	7	8	7
Flesh colour	3	3	6	7	5	3	4	2	2
Skin colour	pi	w	yr	r	p	p	y	w	w
Eating quality**	7.7	7.6	7.5	7.7	7.4	6.6	7.5	7.3	6.9
Dry matter %	23.5	24.1	24.5	23.4	23.6	19.9	24.5	23.0	22.9
Crisp colour	6.7	5.0	6.4	7.1	7.2	5.3	6.6	6.0	5.8
Disintegration	5	5	4	5	4	2	3	5	2
24 hr. discolouration	9	8	8	9	7	9	9	9	9

*Marketable yield is yield of ware 40-80mm in size (P. Dell=100.)

** Eating quality scores based on the assumption of a preference for high dry matter floury varieties

(p) Provisional data

CHARACTER SCORING INDEX

Foliage Maturity	1 = very late foliage maturity, 9 = very early foliage maturity
Common Scab	1 = low resistance, 9 = high resistance
Foliage Blight	1 = low resistance, 9 = high resistance
Tuber Shape	1 = round, 3 = round oval, 5 = oval, 7 = long oval, 9 = very long oval
Eye Depth	1 = very deep, 3 = deep, 5 = medium, 7 = shallow, 9 = very shallow
Flesh Colour	1 = white, 3 = cream, 5 = light yellow, 7 = yellow, 9 = deep yellow
Skin Colour	w = white, y = yellow, p = particoloured, yr = yellow russet, pi = pink, r = red
Eating Quality	1 = very soapy wet potato, 9 = very dry, floury potato
Crisp Colour	1 = very poor crisp colour, 9 = excellent crisp colour. A minimum score of 6 is generally acceptable
Disintegration	1 = no disintegration on cooking, 9 = total disintegration
24 Hour Discolouration	1 = severe discolouration after 24 hours, 9 = no discolouration 24 hours after cooking

How Can You Keep Out Internal Rust Spot ?

DENIS BUCKLEY is ADAS National Potato Specialist. He is based in the West Midlands but his work covers all the main potato growing areas of GB. in addition, he has consulting experience in Egypt and New Zealand.

Internal rust spot (IRS) is a problem which occurs in most of the main potato growing regions of the world. It is known as 'internal brown spot' or 'internal heat necrosis' in America and 'fleck' in Australia and New Zealand. All of these names describe the symptoms well: the affected areas are brown or rusty in colour and development is usually (though not always) associated with hot weather. IRS has long been associated with lighter soils, probably because it is known to be a stress-related disorder.

Symptoms can range from a fleck or two in the flesh to quite large blotches, individually up to 1 cm in diameter. There are often blotches of different sizes and intensity of colour within individual tubers. Where IRS is very severe, cavities can develop in the flesh of tubers.

CAUSE

As long ago as 1911 in Australia, there was the suspicion of a link to calcium (or rather lack of it) during tuber bulking. But it wasn't until the 1970s when that link was proven. Then, in work at HRI Wellesbourne in Warwickshire, it was shown that when Maris Peer was grown in pots of vermiculite supplied with different nutrient solutions, it developed internal rust spot when calcium was excluded. Further work at Wellesbourne was able to demonstrate differences in varietal susceptibility.

VARIETIES

The variety in which the incidence of IRS is greatest in GB is currently Maris Piper. Although in itself only moderately susceptible to the disorder, the large acreage grown, its progressive move to lighter soils, the market demand for large tubers and the intolerance of the market for anything less than perfection has pushed the problem to the fore in this variety. Nadine has not proved to be particularly susceptible in GB, but growers in Australia and New Zealand do complain about it. Estima, like Maris Piper, is moderately susceptible. In the crisping category, Atlantic is very susceptible, while Saturna is moderately so. Hermes, which is taking an increasing acreage of this market, has so far proved be bullet-proof. Also bullet-proof, but grown for different markets are Pentland Dell and Desiree. At the other end of the spectrum, Cultra, a potential Cara replacement, was effectively killed-off in England by IRS in the hot seasons of 1989 and 1990. Not having experienced the same problems in Scotland, Cultra continued to be grown up there during the 1990's, but real trouble in 1999 will cause a reappraisal of its future among some growers.

EFFECT OF WEATHER

We have seen severe IRS in cool, wet seasons (1988) as well as hot dry ones (1989-'91, 1995), and in seasons which show a bit of both, such as 1997. It seems as though extremes of weather tend to increase its incidence and American experience bears this out.

Soil temperature also plays a part, in that exposure of tubers to high temperatures increases the incidence of IRS, and there is some thinking that high night time temperatures may predispose crops to it. Late July and early August certainly provided the right conditions this year.

CONTROL OF IRS

The only way to guarantee an IRS-free crop is not to grow potatoes, but there are undoubtedly techniques available to most growers which can reduce its incidence. Here are my opinions on their likely success (or otherwise) in reducing the risks.

Spraying calcium salts on the foliage

Most unlikely — Very likely

For the most part, calcium is passively absorbed by roots along with water from the soil, and moves passively through the plant in the transpiration stream. Since that stream is almost entirely upward to the leaves, spraying calcium onto foliage is only likely to increase the amount in those parts of the plant already adequately supplied. Therefore, this treatment is unlikely to increase the calcium supply to the tubers. In a British Potato Council (BPC) funded experiment at ADAS Gleadthorpe in Nottinghamshire in 1988, foliage applied calcium nitrate did not increase tuber calcium. Not only that, but calcium applied to foliage in early July could not be detected in new foliage at the end of July. In other words, calcium moved neither down to the tubers or up to new foliage. This gives an indication of just how immobile calcium is in the plant.

Incorporating calcium in the soil pre-planting

Most unlikely — Very likely

British arable soils, unlike many of their American counterparts, already have a lot of calcium in them. Typical soil analyses for magnesium and calcium from fields producing crops with severe IRS in the West Midlands are as follows:

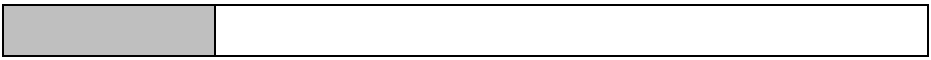
Available Ca (mg/litre)	*Available Mg (mg/litre)*	*Mg Index*
1870	134	3
2210	144	3
1530	80	2
1540	55	2
1140	67	2
1170	49	1

Magnesium is included here because it is chemically very closely related to calcium; the table shows just how much calcium there is in our soils relative to magnesium. Also, crop removal of either nutrient by potatoes is not exactly startling. A 50 tonne/ha crop will shift more magnesium than calcium (approximately 15kg/ha Mg against just 10kg/ha calcium) even though there is much less magnesium available in the soil.

In other words, we are not exactly tripping over evidence that potatoes are severely short of soil-available calcium. Having said that, there is some old UK data from Yorkshire which shows that lime (calcium carbonate) in the seedbed can reduce IRS. In the BPC-funded experiment at ADAS Gleadthorpe already referred to, gypsum (calcium sulphate) applied to the soil pre-planting did significantly increase tuber calcium (it was the only treatment in the experiment to do so). But despite using Cultra as the experimental variety, we encountered very little IRS, so we could not draw firm conclusions as to whether it would reduce IRS or not. In experiments in the USA, soil applied gypsum has sometimes, but not always, significantly reduced IRS. To apply a legal interpretation to the existing data, we could say that the case for soil-incorporated calcium in reducing IRS has not been proved *beyond all reasonable doubt*, but on the *balance of probability* is likely to be a useful tool.

Further BPC-funded work is being carried out at ADAS Gleadthorpe looking at the role of gypsum in affecting the distribution of calcium within the plant.

Broadcasting calcium salts post-planting



Most unlikely Very unlikely

It appears unlikely that spreading calcium salts over the ridges post-planting would increase tuber calcium and decrease IRS. The calcium ion, like that of potassium and magnesium, carries a +ve charge and as such becomes attached to clay particles in the soil. It is therefore likely that calcium applied post-planting will be effectively locked-up close to the soil surface, with very little being available to the crop in the year of application.

Maleic hydrazide (Fazor or Source)

Most unlikely Very likely

In the USA, MH has been one of the materials which reduced IRS in some experiments, perhaps because by stopping cell division it reduces overall demand for calcium. For maximum efficacy, MH needs to be applied relatively early in the label window. However, applying it too early can reduce the yield of large tubers. This would not matter with crisping crops, but it would where a large baker fraction was required.

Later planting

Most unlikely Very likely

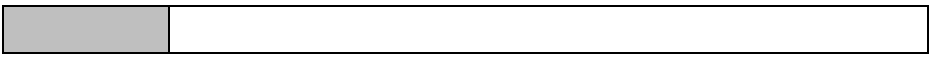
US experiments do show a reduction in the incidence of IRS from delayed planting. This is probably because the crop is less mature at harvest so that the condition has had less time to express itself. Also, with a later planted crop, the average tuber size will be smaller, and it has been repeatedly shown that smaller tubers are less susceptible than larger ones. Tightening-up the seed rate would have a similar effect, because again you would be reducing the average tuber size produced.

The problem with later planting is not only delayed maturity and harvest, with lower yields of smaller tubers etc, but also delayed expression of IRS. This means that you can have a crop with little or no IRS at harvest, but which then develops symptoms in store.

Using a nematicide – Soils with many free-living nematodes

Most unlikely Very likely

Using a nematicide – Soil without free-living nematodes



Most unlikely Very likely

There are some good but limited data from ADAS showing a reduction in IRS where Temik (and to a lesser extent Vydate) was used to control spraing. We also have anecdotal evidence from areas with soils that are heavily infested with free-living nematodes that Temik used at spraing-reduction rates also reduces the incidence of IRS. What may be

happening here is that Temik is reducing the damage to roots caused by free-living nematodes, which, in turn is improving calcium uptake during the growing season. Anecdotal evidence also points to poor PCN control increasing the susceptibility of crops to IRS.

Establishing a cover crop

Most unlikely Very likely

Again, there is some old work from Yorkshire demonstrating the benefits of rye as a winter cover crop (green manure) in reducing IRS. It is not clear why it had that effect. Perhaps the remains of the cover crop are diverting the attention of free-living nematodes from the potatoes, but it certainly seems to be another good reason why growers should seriously consider establishing cover crops before potatoes.

WHERE TO NEXT?

With the market driving quality standards ever higher, it is important to have measures to hand that should minimise the risks. However, there is one thing which is sure to come out of any future experimental work on this subject - there will be no cheap or easy solutions which will guarantee the complete absence of this disorder in your crops.

Decision Support Systems for Late Blight Control

LESLIE J. DOWLEY AND ROBERT LEONARD,
Plant Protection & Breeding Department, Oak Park Research Centre, Carlow

INTRODUCTION

Late blight caused by *Phytophthora infestans* (Mont.) de Bary, is the most destructive disease affecting potatoes in Ireland. The disease overwinters each year in the form of infected tubers. During the growing season these infected tubers can produce sporangia on diseased stems. These spores are spread by wind and rain to neighbouring plants and an epidemic can develop very quickly. Towards the end of the season the spores can be washed into the soil where they can infect the developing tubers and thus the disease cycle is complete. The epidemiology of disease is very dependent on temperature, relative humidity and rainfall. Due to the huge influence of weather on the development and spread of late blight, it is not surprising that forecasting systems are in use in many countries. Met. Eireann has provided a national potato blight warning service for many years. Warnings of weather expected to be conducive to the spread of potato blight are issued as appropriate by the Met. Eireann on radio and television. They are normally issued in advance of a major blight spell so that the grower has an opportunity of spraying.

Recent developments in weather recording technology and advances in computer programming have led to the development of decision support systems (DSS) which produce blight control programmes for individual crops. This paper looks at the results of experiments with different DSS programmes at Oak Park over the period 1996-1999.

DIFFERENT SYSTEMS

A decision support system is a computer-based programme which records and analyses historic weather data and will predict the date of the first and subsequent fungicide applications. At present there are a large number of DSS in operation in Europe and of these the most common are Negfry (DK), Prophy (NL), Plant Plus (NL) and Simphyt (D). The objective common to these DSS is to achieve the most appropriate timing of each fungicide application. However, some of the systems have a greater emphasis on reducing fungicide inputs. Over the last four years, the work at Oak Park Research Centre has concentrated on the performance of the Negfry decision support system using weather data generated within the crop by a Hardi Metpole automatic weather station.

EQUIPMENT REQUIRED

To operate the Negfry decision support system you require an in-crop weather station

(e.g. Hardi Metpole) which will record humidity and temperature at 1.5m as well as rainfall. The Hardi Metpole will also record wind speed, soil temperature and soil moisture which can be important barometers for spraying, planting and irrigation. The data is recorded every 10 minutes and the average of all 3 readings is then automatically transmitted by radio signal to a receiver. The data is then transferred to your computer where it is stored for final analysis using the Negfry software. This software requires an input of emergence date and variety resistance and then it will calculate the accumulated risk value which determines the date of disease outbreak and by use of blight units it will determine the dates of subsequent sprays. The programme is normally run every morning and a graphic display will quickly indicate how close you are to the first or subsequent sprays.

WHY USE A DECISION SUPPORT SYSTEM?

In the current climate there is increasing consumer demand to improve the health status of our foods and to reduce any pollution effects on our environment. This has resulted in a growing international demand to reduce the use of pesticides in food production.

Some countries have already introduced legislation to reduce the use of pesticides in crop production while in others the legislation is still pending. In countries where no such legislation exists, the larger food outlets may insist that their produce is produced according to a protocol that includes reduced fungicide inputs. This may also involve justifying the use of each fungicide applied. This can only be achieved by the use of a decision support system.

A DSS can also be used to reduce the cost of or increase the precision of fungicide applications. However, in the absence of any requirement to reduce or justify fungicide inputs, routine spraying may still be the most practical method of fungicide application.

OBJECTIVES

The main objective of the Negfry decision support system is to reduce the total number of fungicides applied to the potato crop while at the same time achieving acceptable foliage and tuber blight control. This investigation was designed to establish if these objectives could be achieved.

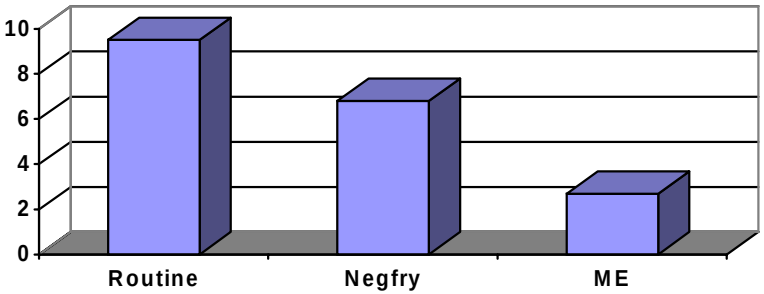
RESULTS

Trials with the variety Rooster were carried out at Oak Park Research Centre from 1996-1999. Routine application of mancozeb at 10-day intervals was compared with an unsprayed control, mancozeb applied according to the Nefry programme, fluazinam applied according to the Negfry programme and mancozeb applied according to the blight warnings issued by Met. Eireann (ME). The trials were carried out according to the EPPO guidelines for fungicide efficacy evaluation. The measurements taken included number of sprays applied, the delay in disease onset, foliage blight, tuber blight and yield.

NUMBER OF SPRAYS

In terms of the number of sprays applied the greatest reduction was with the ME warnings where there was a saving of 60% in the number of sprays applied compared with the 10-day routine programme. Over the four years the average reduction in the number of sprays for the Negfry programme was 30% (Fig. 1).

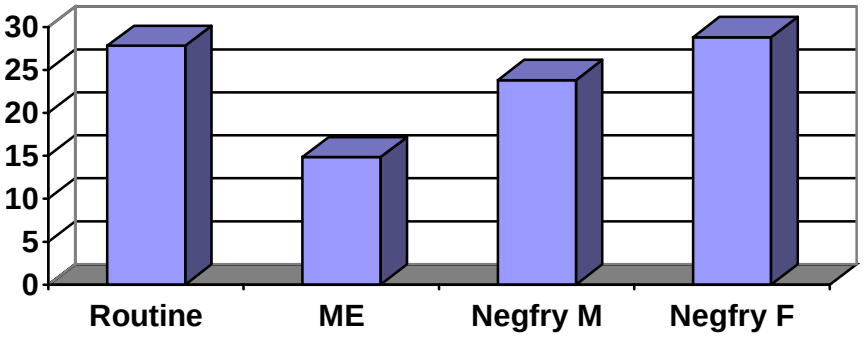
Fig. 1. Mean number of sprays 1996-'99



DELAY IN DISEASE ONSET

Fluazinam applied according to the Nefry programme (Negfry F) resulted in the longest delay in disease onset (Fig. 2). This was followed by the routine programme and mancozeb applied according to the Negfry programme (Negfry M). This would suggest that with the Negfry programme, fluazinam is a better fungicide than mancozeb. The ME programme was significantly less effective in delaying the disease onset when compared with the other sprayed treatments.

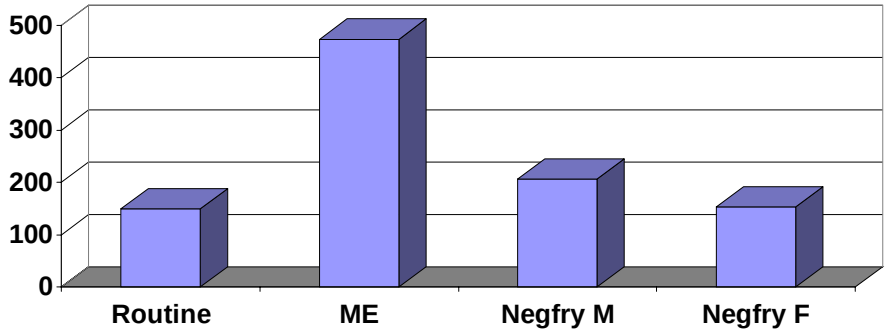
Fig. 2: Mean delay in disease onset in days 1996-'99



FOLIAGE BLIGHT

In terms of foliage blight control the ME programme was least effective and the level of control would be unacceptable. The level of control following the Negfry programmes were similar to the routine 10-day programme but again fluazinam gave better results than mancozeb (Fig. 3).

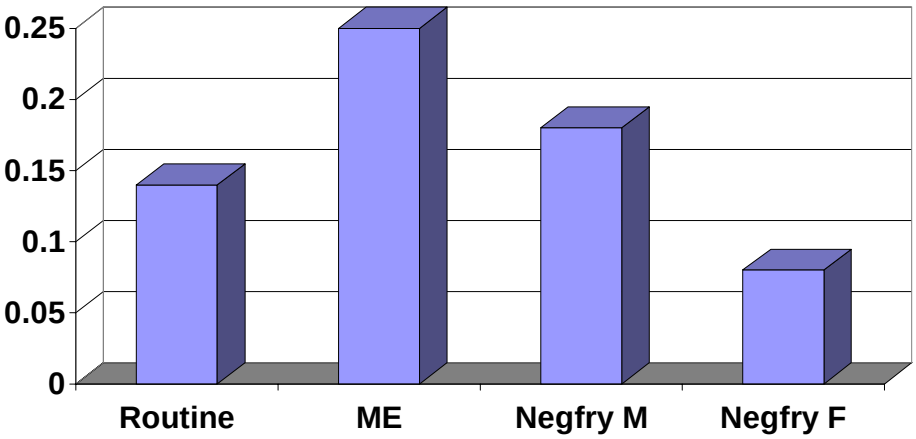
Fig. 3: Mean foliage blight 1996-'99 (AUDPC)



TUBER BLIGHT

The highest level tuber blight was recorded following the ME programme. The Negfry programmes were similar to the routine mancozeb programme but again the fluazinam treatment resulted in much better control than mancozeb (Fig. 4).

Fig. 4: Mean tuber blight 1996-'98 (t/ha)



YIELD

All sprayed treatments were significantly better than the unsprayed control. Within the sprayed treatments there were no significant differences between treatments. Within the Negfry programmess the highest yield was recorded higher following the fluazinam treatment but the yield increase was not significantly higher than the mancozeb treatment.

CONCLUSIONS

1. The Negfry decision support system resulted in a 30% reduction in spray numbers over the period 1996-'99.
2. The Negfry programme resulted in similar foliage and tuber blight control when compared to routine application of mancozeb at 10-day intervals.
3. The Negfry programme resulted in better disease control when the fungicide was fluazinam rather than mancozeb.
4. The Met. Eireann blight warnings did not give satisfactory control.
5. The Negfry programme may give problems with tuber blight control if used in conjunction with varieties which are very tuber blight susceptible.

REFERENCES

Anon. 1978. EPPO guidelines for the biological evaluation of fungicides, European Plant Protection Organisation, Paris.

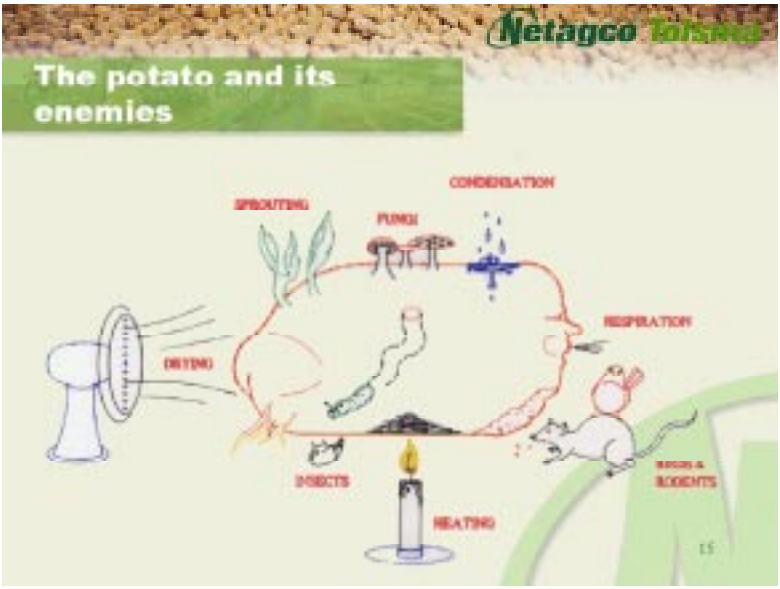
“Controlling the Store Environment”

KEES J. WIJNGAARDEN

Netagco Tolsma is part of the Netagco Group and together with our sister companies we form the Netagco Potato Division.

Netagco, Netherlands Agricultural Companies, is a group with a turnover of approx. Nlg. 450 million and 700 employees. The group is growing and growing and latest also Welvent Ltd. is joining the Netagco Potato Division.

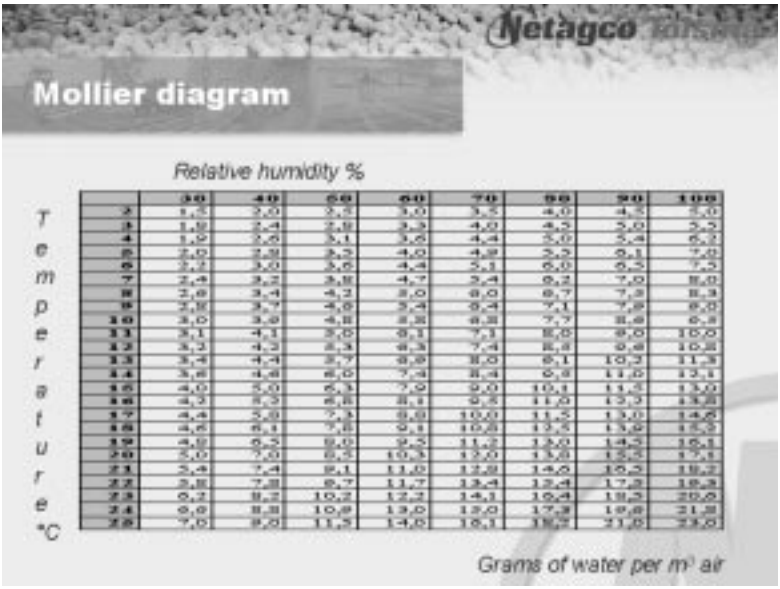
Today I will not talk about ventilation systems, like airing ducts on the floor or in the floor and letter-box-systems or space ventilation systems, but I want to talk more about all the things which might go wrong in your potato store.



Which problems might arise in your potato store, where do they arise, how can you see them and, not unimportant, *what can you do on it.*

The majority of the problems which occur later during storage can be solved by preventive care. In practice it means that you have to look after a lot of little things, like putting the tipping trailer inside during lunch/coffee break, checking the temperatures during harvest/instore etc. etc.

The red line during the whole storage period is the Mollier diagram.



In principle you should check all day:

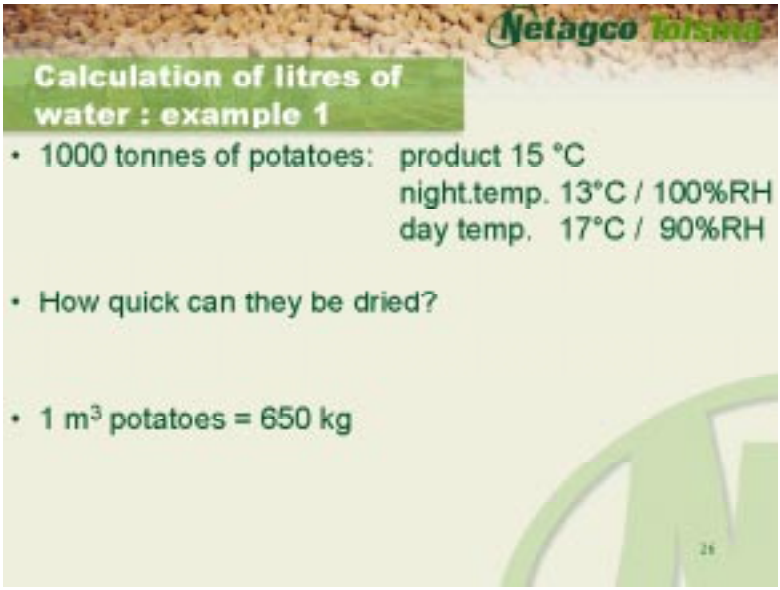
Temperature of the product	}	Figure A
Relative Humidity of the product	}	
Temperature of the air	}	Figure B
Relative Humidity of the ai	}	

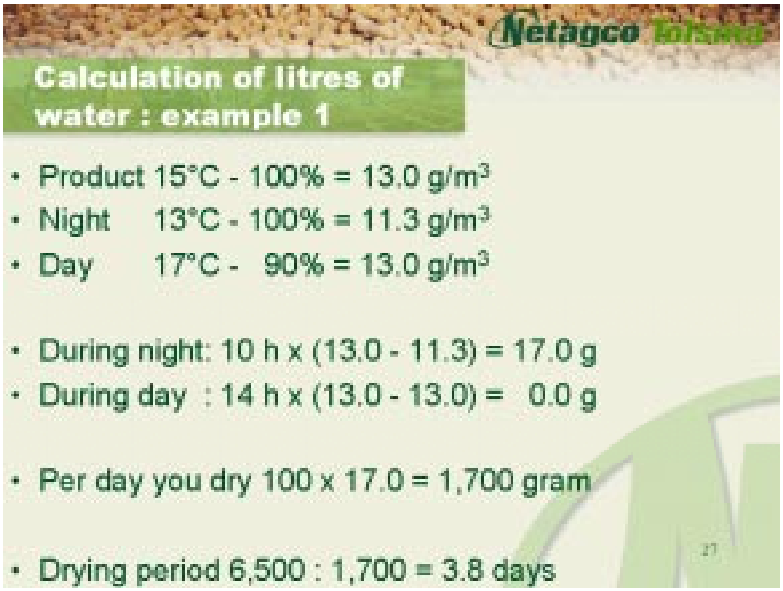
*** For drying figure B should be lower than figure A

Continued on page 44

It is always good to know **how many** litres of water have to be evaporated for drying your product.

The following examples may clear it out.

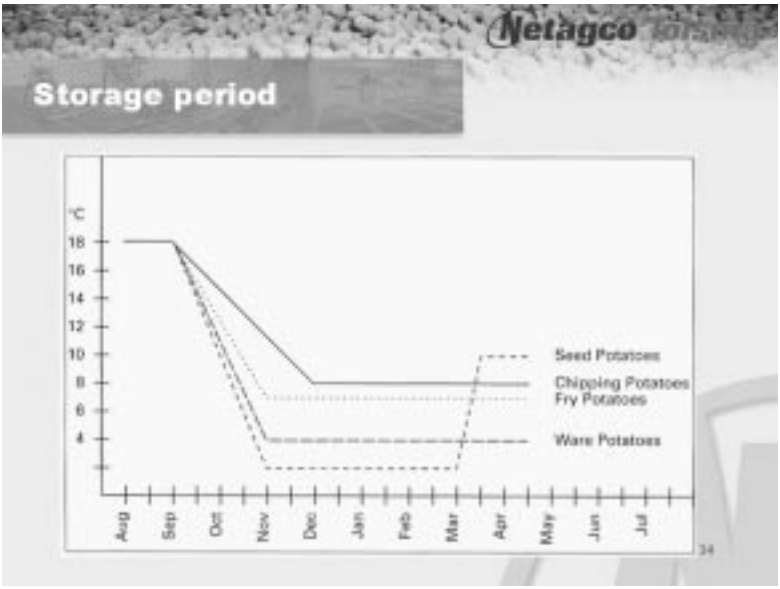




To prevent pressure spots a proper wound healing period is "**a must"** for storing potatoes.

It is to be advised to have a wound healing period of 2 weeks.

The storage period afterwards depends mainly on the potatoes. I mean do you store seed potatoes, table potatoes or potatoes for the French Fry Industry.



Another big problem in your store is the condensation at the roof or ceiling.

It depends of course on the thickness of the insulation and how it is constructed, but if there is a difference in temperature for a longer period, let's say a week time, definitely condensation will arise, most of the time visible at the roof or ceiling.

The following will show how it goes in practice

and **how it can be solved !!!**

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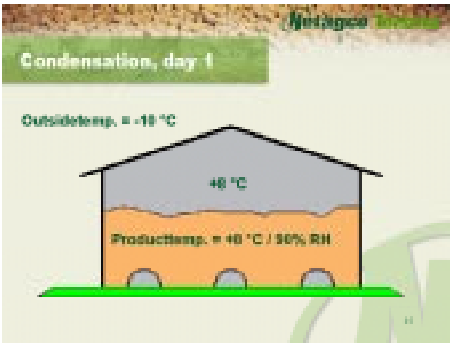
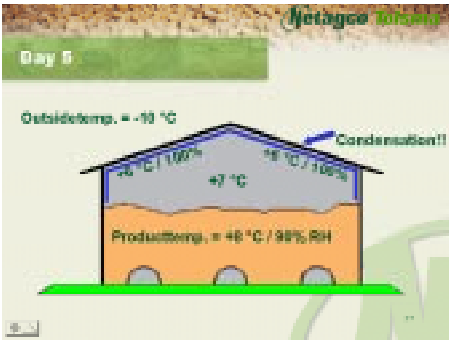
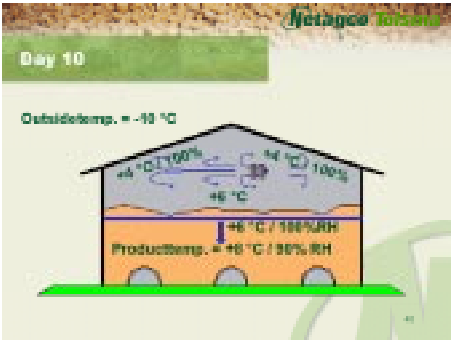
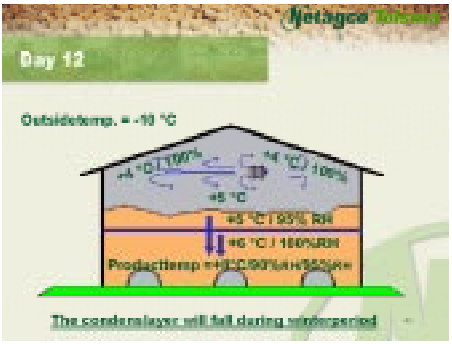
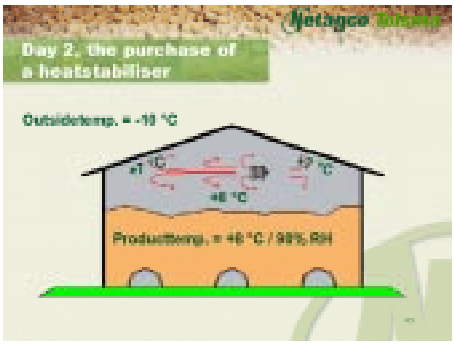


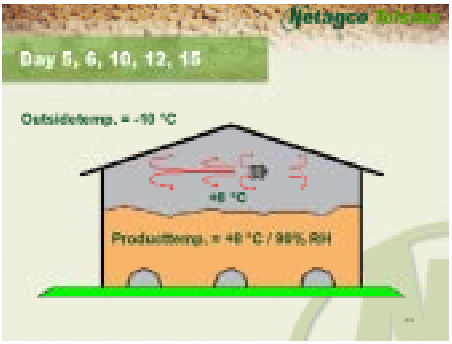






and **how it can be solved !!!**





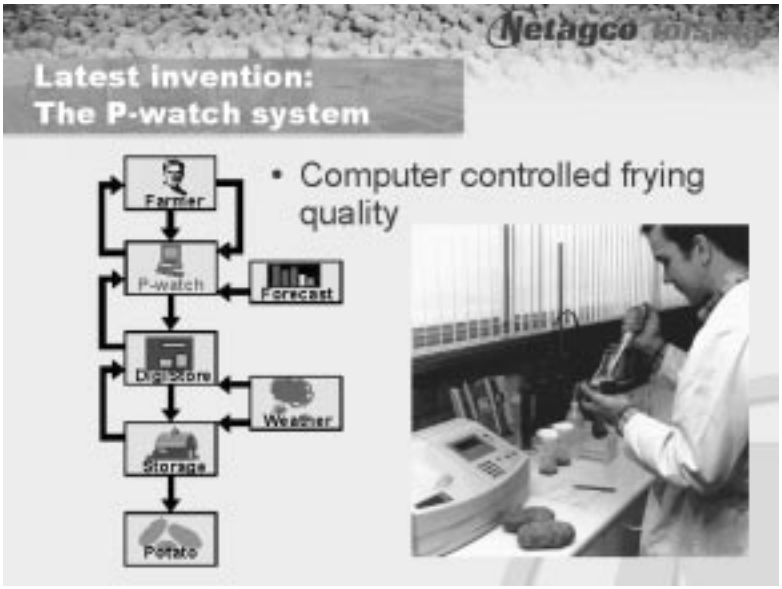
Problems with frying colour can be solved in future with help of the P-watch system.

This is a system with which we can calculated in advance how long your potatoes can be stored for the best baking/frying result.

In practice we take a sample of your potatoes every 4 weeks and make tests with it in our labority in Emmeloord. Together with the characteristics we have of that particular variety and the mentioned tests it is possible to create a software program.

This computer software program can be connected to the process units of your store house and from that time on everything will go fully automatic.

So you will know in advance how long you can store.



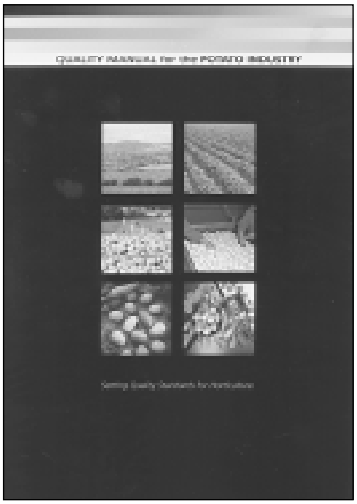
Finally some practical tips:

- Try to prevent any damage during harvest and instore
- Make sure all wounds are healed properly
- Cool down with temperature differences of 2 – 3 ºC.
- Heat up with temperature differences of 2 – 3 ºC.

And as I understand that there is much more that I just have told you, we wrote a small booklet about potato storage. I wish you a lot success in storing.

The Quality Programme Explained

BRIAN ARNOLD
Development & Marketing Executive
An Bord Glas



WHAT IS QUALITY?

There are many interpretations of quality food. Traditionally consumers think of food quality characteristics like taste, blemish free appearance and standardised size or a combination of all three. In recent years consumers are linking the traditional reference points of quality with the need for assurances that the food which we are eating is safe and that it has been produced in a manner which is environmentally friendly. Many producers of horticultural produce will say that they have always been producing safe food and looking after the environment at the same time. However, is this reassurance sufficient to meet the needs of today's marketplace? The answer is a very clear and categorical No. Today's market is demanding that food fulfills the traditional quality characteristics and that it also provides the consumer with the confidence to purchase and consume the product.

Confidence has been struck many body blows in recent years on account of international food scares. We all need confidence in a product if we are to purchase it on an ongoing basis. We are therefore dealing with a fundamental feature of marketing, do we have full confidence in the quality of what we are producing and selling and furthermore can we underpin this confidence with proof. Whether a food item is purchased in a supermarket, garage forecourt, roadside stall or directly from your farmgate, consumers still need confidence. Consumer concerns rapidly become retail and manufacturers concerns as evidenced by the rush to remove any trace of GMO foods from retail shelves. Consumer concerns are therefore producer concerns. This raises the question as to how producers can provide proof of confidence in their products or what we can describe as Quality Assurance.

THE BORD GLAS QUALITY PROGRAMME

Bord Glas identified the need for an independent system of quality assurance in the early '90's. Establishing quality standards and a mechanism for undertaking independent auditing was the first challenge facing Bord Glas. It was decided to define quality standards in terms of current legislative requirements and operational practices that were considered to be Best Practice and to document these standards in sectoral Quality Manuals.

Independent quality consultants, acting on behalf of Bord Glas would undertake the auditing of participating enterprises. This modus operandi ensured that the programme could be easily expanded in line with increasing demand, and that there was complete objectivity in the auditing process. The other principle underpinning the programme is that participation is voluntary. This principle is very fundamental from the Bord Glas point of view, because participants have to want to make improvements in their quality standards if they are to participate.

Quality Manuals were developed for all the main sectors of the horticultural industry, initially with protected food crops and mushrooms, and followed by field vegetables, soft fruit and potatoes. These Manuals were used to define the standards on which the Quality Auditing is based. In 1998/1999 the Quality Manual series were revised and updated to take account of legislative and marketplace changes.

The Quality Programme was initially targeted at growers of vegetables and fruit. The potato sector was initially targeted via prepackers since 1996. Currently all the major prepackers are participating in the scheme. In 1998/1999 potato growers began participating in the programme and we expect potato grower participation to increase significantly over the coming years.

All participants in the programme will be provided with the relevant quality manuals depending on which products they are producing or prepacking. On an annual basis participants will undergo two independent audits and they will also be provided with self-assessment documentation to encourage participants to undertake their own quality system checks.

WHAT IS AN AUDIT?

The audit is the process whereby a quality auditor will visit and inspect the horticultural enterprise against a set of defined criteria. A single checklist has been compiled by Bord Glas to assist with standardising the audit procedure. The checklist covers the following areas:

- Cropping practices
- Hygiene and Quality
- Packhouse
- Store and cool chain facilities
- Crop protection products
- Records
- Documentation
- General

This checklist has been designed as a generic listing for any grower or prepacker that is participating in the programme. Therefore not all the headings listed on the checklist will be applicable to every enterprise. Auditors will explain the checklist and the details of the quality manuals during their first visit. This will help to highlight the scope of changes

and improvements that need to be undertaken by participants, if they wish to be formally recognised under the Quality Programme. Both the auditor and the participant sign a copy of the completed checklist. One copy of this checklist is provided to the participant for their information and future reference. Both the details of the checklist and the discussion with the auditor will set the targets for future improvements on the enterprise.

Introducing and maintaining the standards for the Bord Glas Quality Programme will not happen overnight. The best approach is to consider what improvements need to be undertaken and set out a plan of action for undertaking these improvements over a time span which suits your enterprise. This will normally be between a six month and a two year period, depending on the changes needed and the dynamics of the enterprise. It is also common that horticultural enterprises are planning to undertake new investments in terms of buildings and equipment. These situations lend themselves to incorporating the quality controls and systems into the future working environment rather than spending time and effort on existing facilities which will be superceded in due course.

Bord Glas seeks to recognise enterprises that have established high quality standards by presenting a Quality & Hygiene Award. A Certificate of Merit will be presented to enterprises that have made significant quality improvements to their enterprises, but which are not sufficiently developed to be presented with a Quality & Hygiene Award.

CRITICAL AUDITING ISSUES

While the relevant Quality Manuals define standards required, there is a range of critical auditing issues that need highlighting as follows:

Records

- Records are the basis for your traceability system.
- All records must be available for inspection on the day of the audit and up to date.
- The Health and Safety Statement must be completed and available.
- The chemical usage record must be complete, clear and accurate. The chemical usage record can be kept on the crop record charts available from Bord Glas.
- The weighing scale calibration record must be available to show that the weighing scales are calibrated at a minimum of once per year.
- Where the weights and measures specialists carry out the calibration, a record of when the calibration is carried out and the person who undertook the calibration should be available.
- A pest control management system should be in place.

Hygiene/Quality

- The facilities of the site should be clearly designated and sign posted for the various functions as required. These include a separate canteen, toilets (must not be opening into packing area), packaging store, packing area, general store and chemical store.
- Crop Protection Products

- Only approved chemicals should be available on site.
- Chemicals should only be stored in a designated chemical store. Ensure that they are safe (locked) and secure so that no leakage can occur.
- The safe disposal of chemical containers (empty or containing product) is important from a safety and environmental point of view. They should be dealt with as follows:
  — Discuss the disposal with your marketing company (where appropriate) and investigate if they can organise disposal.
  — Discuss the disposal with your chemical supplier and investigate the option of them disposing or assisting you to dispose of the containers safely.
  — Investigate the safe disposal with your local authority, to see if they can take these containers and if they have an appropriate safe mechanism for disposing of them.

Environmental safety and chemicals

- As a general rule, producers should only make up the exact amount of chemical they need to apply, thereby avoiding the situation of having to dispose of any left over chemical solution.
- The disposal of washings from application equipment should avoid contamination of open water or rivers. Any washings (well diluted) should be washed/drained directly into an appropriate soakaway with an appropriate filtering mechanism (e.g. sand/silt) to aid the removal and dilution of any potential pollutants. Alternatively, waste solution can be stored in a holding tank, which must be emptied by a licensed operator.

Pesticide Training Course

- Participants must complete in a Pesticide Training Course and achieve accreditation.

General

- Plastic and plastic containers should not be burnt.

  Plastic waste: — should be carefully collected and returned for recycling.
  — If a recycling option is not available then it should be disposed of in an approved local authority waste disposal facility.
- Fuel tanks must be bunded adequately to avoid leakage or spillage.

First Aid Training

- At least one person must be on site at all times with basic First Aid training.

CONCLUSION

The Bord Glas Quality Programme has been specifically designed to meet the needs of the horticultural industry. In line with today's consumer demands, the programme

establishes quality assurance controls which will facilitate the ongoing marketing and promotion of the industry. From a producer's point of view, the programme is readily accessible and achievable. The programme is built on the fundamental principles of independence of auditing and voluntary participation.

Increasing the level of participation of potato growers in the Quality Programme is a current Bord Glas target. This will complement the already high levels of quality accreditation achieved by the prepacker sector and assist with expanding strong quality systems throughout the horticultural supply chain. Shifting mindsets, to thinking Quality Systems, is often the biggest first step for producers to take. It's a step that will help sustain a competitive future for the potato industry.