Factors influencing current U.K. strategies to meet quarantine requirements for export grain

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Abstract

The United Kingdom annually exports over 5 million tonnes of cereal grains to around 50 countries worldwide. Many shipments are accompanied by International Phytosanitary Certificates issued by the U.K. government in respect of grain inspection procedures and apparent freedom from quarantine insect and mite pests.

Nationwide, over 40 ports ship grain in vessels ranging from 1000 to over 50000 t. A very flexible grain supply, storage and loading system has evolved. However, this flexibility increases the risk of last-minute detection of storage pests during loading, in turn jeopardising the issue of the commercially-valuable phytosanitary certificate.

Most of the grain supplied to the docks is believed to confirm to contract specification, which includes freedom from pests, though infestation assessments are usually made on arrival, and not in store of origin. Pests thus detected may result in extremely expensive and sometimes technically difficult in-ship fumigations.

The multiplicity of grain sources to fulfil export consignments and the unpredictability of the results of dockside sampling, ensure that exporters will prefer to reduce their risks by the continued admixture of pesticides. Improving the reliability of insect detection, perhaps by engineering solutions to sampling and sieving, will encourage the sourcing of grain supplies from expertly-managed stores.

Introduction

There has been a steady increase in the annual tonnage of cereals harvested in the United Kingdom since the end of World War II. Approximately 15–20 years ago a degree of self- sufficiency was achieved, due to the combined effects of varietal and agronomic factors and the pricing arrangements under the European Economic Community's (EEC) Common Agriculture Policy. The influence of flour millers was felt by their gradual replacement of imported wheats (mainly from the USA and Canada) with carefully-bred British varieties. Self- sufficiency naturally led to surpluses, currently around 5 Mt annually, and Britain's entry into the EEC in 1973 resulted in the establishment, for the first time in the U.K., of (government) intervention 'storage'.

The intervention system rapidly established high quality standards for grains to be accepted into storage, including thresholds for certain parameters, such as moisture content and admixture (of non-specific grains). Some parameters were set at levels stricter than those pertaining at the time in commercial grain trading. For a number of specified invertebrate grain pests there was a zero tolerance. For others, considered to have less potential for serious damage, store managers could use their discretion if they were discovered on intake, though this frequently was effectively also a zero tolerance. A comprehensive storage manual was produced by the U.K. Home-Grown Cereals Authority, whose advice was followed very closely by the great majority of contracted storekeepers. This placed particular emphasis on routine sampling and assessments of bulk grain in store.

Grain Exporting

Although the U.K. had exported small consignments of grain over many years, a major export program started in the winter of 1978. To take advantage of the good trading climate, exporters used most of the available ports around the coast of England and south Wales, and many of the Scottish ports. The National Dock Labour Scheme was still a strong influence at the time, with working practices in scheme ports being closely controlled and often restrictive. Thus, many exporters preferred to ship from smaller, private ports and wharfs, where extended working hours (24-hour loading at some) and flexible labour arrangements were available.

Grain cargoes from the smaller ports varied from 1000 to 3000 t. This was often dictated by the size of vessel which small locks or tidal basins could handle. However, this was not necessarily a disadvantage, since for many years the eastern European communist bloc countries were major buyers. For a number of these countries across the North Sea, the cargo route involved the rivers and canals of Europe, where shallow drought vessels were necessary. The USSR had two large fleets of vessels for this trade, the *Ladoga* and the *Baltiskiy* ships, servicing much of the Russian, Polish and East German imports and using the Elbe river and the Kiel canal. Other cost-effective voyages for small bulk cargo vessels were the transhipments of U.K. grain to the western European coast, especially to Rotterdam, where large, deep-sea vessels could be loaded simultaneously from a number of small ships and barges, through 24-hour working.

The majority of the smaller U.K. ports had very limited grain storage and handling facilities.

In these circumstances it was common for ships to be loaded directly from a succession of bulk grain lorries (road trucks). In 1978 most lorries had a capacity of around 15 t, the larger, 25 tonners being uncommon. Farmers near export points often arrived with their grain, directly ex-farm store, in I0 t trailers pulled by tractor! Although such direct loading via mobile or fixed conveyors might seem unsophisticated, lessons of uncertain and interrupted supplies were learnt, and the U.K. grain trade rapidly adapted to the vagaries of weather, vessel arrivals, tides and transport, to develop a particularly effective network supply system. This development has stood our

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exporters in good stead over many years, since they are not now solely dependent on a small number of larger, deep-water ports. The positioning of our small ports on all coasts also helps to minimise costs, since there is little grain harvested which needs to travel more than about 150 km to reach a reliable export point.

Concurrent with this increasing trade in small cargoes, major developments were taking place at the large port silos. New and flexible facilities, rapid lorry sampling, assessment and tipping points, and modem vessel loading equipment were all being installed. Many such wharfs were 2-way, capable of outloading from silos and dockside stores, as well as importing grain and bulk feeds by reversible handling equipment. Some of the large dockside complexes have associated flour and animal feed mills, allowing considerable flexibility in handling, storing and using both export and imported grains. The larger port silos have capacities around 30000 t, with several smaller sites of up to 15000 t. Since the deep-water berths can accept vessels of up to 50000 t, it can be seen that to load such vessels still requires the direct transport of lorry loads of grain. Thus the lessons of the late 1970s in developing the infrastructure to use the small ports are of continuing value today, when Britain exports to about 50 countries worldwide from over 40 ports (Anon. 1991/92).

Export Quality Certification

From the earliest U.K. grain exports, in the 1950s, there has been a need for up to two types of certification to accompany cargoes. Grain has always been traded against some sort of contract specification and the required checking for compliance by sellers and buyers was accomplished through commercial cargo superintendents. Thus sampling of grain being loaded enabled commercial quantity/quality certificates to be issued in time to sail with the cargo. However, the technical methods used for sampling, to assess characteristics such as admixture (with non-specific grains), moisture content, specific weight and pest infestation, varied considerably from port to port, and between individuals. There was no practical national standard for sampling (but see Appendix 1) and the consistent 'quality' of such assessments often seemed to depend on lack of buyer complaints. Since we had no way of knowing how our overseas customers would assess the quality of cargoes on arrival, a simplistic reliance on lack of complaints was clearly unsatisfactory. 3

Concurrent with the trade-sourced quality certificates, there had been a need to provide official, government-sourced plant health, or Phytosanitary Certificates (Anon. 1991), specifically for those countries which had a reciprocal agreement with the British Government, and which were signatories to the international convention on plant health. Although in the early days these phytosantiary certificates were purely British documents, following our membership of the European Community the EEC format certificate has been adopted (Appendix II). Technically, this is an improvement, since the earlier certificate simply stated a believed compliance with the importing country's quarantine requirements, with no space for comment or additional information. The EEC certificate states that the cargo complies with import requirements, but also includes in the text both quarantine and other pests, and has additional spaces for details of chemical and other treatments, and for comment if other factors have been observed by the government inspector.

As a government service, the dockside inspectors were obliged to follow official guidelines on sampling procedures, to comply with the wording on the phytosanitary certificate ('have been sampled by appropriate means'), and from the start there was recognition that the current British Standard (BS) 4510, 'Methods for sampling cereals (as grain)' should be used as the basis for dockside inspections. However, from the foregoing it will be clear that the great variety of ship-loading systems at so many ports would be reflected in non-uniformity of sampling facilities. Inspectors were expected to make sound technical judgements on the presence or absence of storage invertebrates, in some cases by sampling lorries on open quaysides in the depths of winter and in others by manually extracting samples from a grain stream moving at 1000 t/hour. There were additional problems of staffing such a large number of ports, many of which wished to work extended hours and over weekends and public holidays, and of the technical training and supervision of the inspectors to ensure, as near as possible, consistency of working standards.

The Need for Unified Working Practices and Standards

For many years the Plant Health Division of the British Ministry of Agriculture, Fisheries and Food (MAFF) has relied upon its technical colleagues to operate the inspection service regarding grain assessments for quarantine and other storage pests, while one of its laboratories handled samples mailed in by exporters for disease and weed seed assessments. The combination of both sets of results allowed the issue of the phytosanitary certificate centrally from MAFF HQ in London. Thus, the trade need for a certificate to *accompany* the vessel often could not be met in the case of government documentation.

As the U.K. export trade developed, there was an understanding between the exporters and government departments that some standardisation of procedures and costs (certification is a chargeable service, based generally on the actual time and effort involved for each cargo) was desirable. The wide range of ports and associated facilities was an immediate problem, tackled by collating information on loading systems and inspection methods in use. Using this national database, a document was produced which encompassed standardised procedures for the advance notification of export consignments, practical dockside sample extraction and examination facilities and methods, responses to the discovery of the various pest and non-pest species and, perhaps most importantly, an agreed interpretation of the relevant British Standards referred to above. These aspects were finally published as a 4 working manual for MAFF staff but then circulated through the U.K. grain trade (Anon. 1991/92).

Agreed Standard Operating Procedures

Since many of the small ports that were in the vanguard of the export drive in 1978 are still operating, it was necessary that these guidelines should be satisfactory under loading conditions of a few hundred t per day arriving by lorry load, and equally practical at the major silos outloading at 1000 t/hour with simultaneously operating lorry tipping. A constraint of major importance to the commercial side of the export trade was the inevitable disruption to the throughput of lorries caused by careful inspection on a load-by-load basis. Although the cargo superintendents had sampled export grain, in general they had taken individual scoops from the lorry surface, or collected grain as it tipped from the tailgate. This did not approximate the BS methods and was not practised by the MAFF inspectors. Instead, they preferred to take multiple samples by manual or vacuum spear and examine, by sieving, all of the bulked sample. However, manual sample extraction from up to 100 lorries per day would be impractical and

MAFF therefore agreed to use, in addition, any existing vacuum sampling system.

Such sample extractor units are now commonplace throughout the U.K. grain trade and operate at mills, stores and intervention sites in a broadly similar manner. The moveable arm of the sampler can be directed to extract whole-depth core samples from a wide variety of positions across the lorry. Technical and practical problems remain, such as the possible 'loss' of mites and some fragile insects due to the percussive action of the rapidly moving grain stream, and the inability of some installations to take samples according to the BS recommended 'domino pattern'. However, the main problem is the time taken to assess thoroughly about 5 kg of sample per lorry load. This can cause serious delays in the flow of lorries on quaysides and is due mainly to the speed with which samples can be sieved and examined.

Work done jointly with the French research laboratory at Bordeaux (Wilkin and Fleurat-Lessard 1990) and by CSL (Wilkin 1991) showed just how ineffective manual spear sampling can be. Greatly simplified, the trials showed that only when insect populations reach or exceed 5 insects/kg of grain is manual sampling likely to reliably detect their presence. Between I and 5 insects/kg, the reliability of detection can be significantly increased by extracting larger quantities of grain and, most importantly, examining all of the sample. Below 1 insect/kg (which still is a significant number of insects in a 25 t lorry load) discovering insects was more by chance than design. This level of infestation is probably quite typical of loads found to be infested at the docks. No trader would willingly and knowingly try to export infested grain — the financial costs would be too great. Thus, the detection of insects at low infestation levels in loads, or from silo streams, is almost certainly due to chance. The grain was thought to be insect-free; the dockside inspector, by chance, found insects during his examination. The constraint, mentioned earlier, that lorry inspections and silo flow assessments must be carried out against strict time limits, reduces the possibility of more thorough sampling.

At ports where direct loading from silos occurs, other constraints apply. For some years the U.K.'s health and safety at work legislation (Anon. 1974) has prohibited the practice of manual sample extraction from a moving stream (band, belt or conveyor) of grain. Therefore, it has been necessary to devise automated sample extraction systems. Most silos are now equipped with automatic sampling systems, of varying complexity. In theory the best are those offering continuous by-pass extraction from the main grain stream, the sample returning to the flow after examination. The BS covering the sampling of moving grain streams (Appendix 1) suggests designs for equipment, but due to the many different grain handling methods in U.K. silos, no single design of sampler is possible. Additionally, there is no U.K.-derived research data to show that the 'one-shot' samplers are less effective. Even these types vary, from the relatively crude, chamfered tube set in the grain stream, with manual gate valve or slide, to the more complex arrangements where time-open and the intervals-between-openings are adjustable and operated electrically through time clocks and motors.

Comments on sampling practice have, so far, referred to the government inspection service. The commercial sector also relies heavily on sampling for its contract quality assessments. in general, though, such uniformity as exists is based around simple sampling methods such as scoops and bucketsful of grain from lorry tailgates and acceptance of easy-to-obtain samples through vacuum equipment. In all cases, where the government service has secured improvements in sampling facilities, these have then been accepted and used by the commercial assessors. Many of the 'quality' parameters looked at by the trade are assessed on the basis of averages. Large samples bulked from a number of smaller samples drawn from, for example, each lorry, can be mixed and sub-divided to obtain values approximating the average for the consignment. Factors such as moisture content and specific weight are thus assessed but, as outlined above, such methods are not appropriate to the detection of invertebrate quarantine pests.

The Risks and Consequences of Detection

The aim of sampling in this context is to be able to assess grain lots for the presence of invertebrate storage pests. In contrast to some countries, for example France, British grain for export is not assessed by government inspectors upon loading into dockside silos, The management of the silo may institute its own checks at this point, but because the grain in the bins is not destined specifically for cargoes requiring phytosanitary certificates, it is not 'bonded' and certificated. For the same reasons, neither is grain officially inspected on-farm or in commercial stores in advance of shipments, though this could probably provide a more accurate estimate of its infestation status, especially if invertebrate traps are used (Cogan and Wakefield 1987). Thus all U.K. exports are sampled and checked as close to loading onto the ship as possible, in compliance with the spirit, and wording, of the phytosanitary certificate.

There are obvious risks involved with this system. The exporter seldom, if ever, sees in advance the grain which makes up the shipment. The origins of the grain can be varied, from farm or merchant or intervention store, or dockside sheds and silos, as discussed above. The normal methods of sampling are not accurate in their ability to detect low population levels of storage pests; only positive findings can be relied upon and 6 even these are unlikely to be replicable. Thus infested grain does on occasion, arrive at the loading quay. (Grain ex-silo should have a lower risk of infestation if it has been inspected and sampled on intake.) In view of the need for grain to be 'pest-free', both for commercial quality certificates and for the government phytosanitary certificate, the discovery of insects at the point of loading can be economically very serious. Individual lorry-loads can usually be rejected if found to contain insects, but there are occasions where the grain is in the process of tipping when the discovery is made. In this situation, as with inspection of grain during outloading from a silo, diversion of the infested parcel of grain is not possible and the assumption must be that insects have inadvertently been loaded into the vessel.

The options from this point are severely limited. The grain in the ship may be fumigated, using phosphine gas, but this may incur the additional expense of boarding the crew ashore during the treatment, or of sending a fumigation contractor to accompany the vessel during its voyage 'under gas', to ensure crew safety. Another option is to divert the ship to a destination which does not require certification of the cargo. This is a far from easy option, and will incur some loss of value of the grain. A third option, undertaken with great and understandable reluctance in the U.K., but which is more common in Germany, is to unload the grain for treatment on-shore, sometimes also by phosphine fumigation.

In an attempt to minimise the extreme disruption to trade and the economic consequences of these options, there has been increasing use of admixture pesticides, applied to the grain doting loading. In some cases the treatment is at the behest of the buyer; probably the majority of treatments are used as a precaution against the last-minute discovery of infestation. However, there are technical problems associated with such treatments applied for prophylactic reasons.

Pesticides Applied Directly to Grain

The use of certain pesticides applied directly to cereal grains, a technique developed over many years, is intended either to provide a degree of protection against future attack by storage pests, or as a control method for an existing infestation. A small number of organophosphorous pesticides is approved and registered for admixture in the U.K., although only three active ingredients are now commercially available: chlorpyrifos methyl, etrimfos and pirimiphos-methyl (Anon. 1993). Of the dust and spray formulations, it is only the sprays which are used on grain for export.

When such treatments are carried out in inland grain stores, there is seldom a constraining time factor to their success. Under commercial conditions, although the treatment dosages achieved (in mg a.i./kg of grain) may be variable, and seldom more than about 60% of the intended or target dose, complete eradication of infestation, or long-term protection, is possible and verifiable through trapping programs. The application of sprays to export grain may be by fixed installations set up in the larger silos, most of which would be professionally designed and supervised. Or they could be applied through temporary spray machinery attached to mobile grain conveyors or the outloading spout above the ship's hold. These installations often look inelegant, though there is very little hard evidence to indicate that they are less efficient than the permanent set-ups. It is certain that prevailing weather conditions will affect spray patterns in exposed situations and may cause significant spray drift off the band of moving grain. This aspect must be the subject of research in the near future.

Recent research, funded by the Home-Grown Cereals Authority, has investigated the effects of admixture pesticides against six of the most significant insect species in U.K. grain, at low temperatures over a 28-day exposure period. The results of this trial (Kelly and Amos 1993), which was designed to simulate typical winter conditions during the export season for grain undertaking a long sea voyage, showed that several species could survive exposure on treated grain at very low temperatures (down to 30°C), and that in most cases there was little to chose between the different OP pesticides over the month of exposure. However, for shorter periods, etrimfos in general showed a slight advantage in speed of kill. Since the trial used laboratory strains of insects, which had been conditioned over countless generations to 25°C, results in real-life treatments may be different.

The main purpose of the work was to try to establish if the presence of live storage pests in grain at the time of loading a vessel could be discounted if the grain was being sprayed with a recognised pesticide. The trial was not conclusive, because the practical dockside treatments are not as well-controlled as the laboratory experiments. Even under laboratory conditions, there was difficulty in applying uniform and accurate doses of pesticide. The variations possible when applying sprays in a dock situation, on an exposed quayside, cast serious doubt on the validity of using such laboratory data, without hedging the conclusions in provisos and conditions. Further work to build on the experimental results, to quantify the variables and to narrow down the limits under which total pest eradication can be expected, would be welcomed both by government inspectors and exporters.

Thus, whilst admixture pesticides remain a major element in grain exporting strategies, sometimes at the request of the receiving country or company, complete faith in their use as a general prophylactic against storage pests in export grain is not justified.

Conclusions

A complex of factors has affected the evolution of the British grain export trade. Undoubtedly the number of ports and wharfs around the coast (an historical legacy of centuries of seafaring) has contributed to the flexibility of the system. Had Britain planned a major export drive from the start, we may now be using a small number of very large silo installations, each capable of storing sufficient grain to complete a cargo for a deep sea vessel. Instead, there is a network of producers, commercial stores, government (intervention) stores, over 30 smaller ports with varying facilities and a handful of the large silo complexes. Seen from a purely practical point of view of ensuring that enough grain of the (on paper) correct standard is available when the ship arrives, such a system has real advantages over the less flexible large-silo-only situation.

However, the fragmentary supply chain, though efficient in delivery terms, creates problems in the verification of both quality and quarantine status of the grain shipments. Whenever an export cargo requires a phytosanitary certificate, the grain will be inspected by the examination of samples taken just before loading (lorries) or during loading (silo streams). The methods of sampling currently available are acknowledged to be not sensitive enough to detect all infested lots, yet the diverse sources of grain make pre-delivery official inspection impractical. Thus, dockside certification entails a large risk to the exporter of rejection of loads because of the presence of insects and mites, or of refusal of the commercially-valuable phytosanitary certificate. In the longer term, better methods of sampling are needed, able to cope with large sample sizes for more complete assessment. This development, probably through funded research, will contribute significantly to further enhancing the credibility of the widely respected U.K. phytosanitary certificate.

In the immediate term, exporters have reduced the odds against the unexpected discovery of insects and its consequences by ensuring that most export grain is treated with admixture pesticides during handling and loading operations. If this were done in inland stores, the results would be more predictable. However, the recent trial simulating export grain conditions of temperature and voyage length left the suspicion that such treatments are imperfect. Rather, there is a continuing worry that the far from ideal dockside conditions under which the grain is treated, and the possibility that infestations in grain may be of strains of insects which might exhibit some pesticide resistance, could combine to reduce the treatment efficacy to a point where insect survivors are detectable. Until more research is done to establish and quantify these variables, caution must be observed in translating the present results into firm recommendations for government and industry.

An intermediate step to limit the risks of unintended infestation arriving at the docks is to source the grain from stores operating the best quality management systems. Technically, intervention storage is an obvious choice, and there are heartening signs that the commercial trade is advancing in overall store management terms. This, and the increasing development of farmers' co-operatives with similar storage strategies, could lead to more cost-effective large store management, the commercial acumen of which could be fed back into the intervention system to make models of reduced-cost storage. Exporters would then have a much greater choice of sources of suitable quality grain, whilst minimising the financial risks of dockside certification.

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Appendix I

Standards on Grain Sampling

ISO 950: Methods for sampling cereals (as grain). International Standards Organisation, Committee TC34/SC4 Secretariat, Budapest, Hungary.

ISO 6639/2: Cereals and pulses—determination of hidden insect infestation—Part 2: Sampling. International Standards Organisation, Committee TC34/SC4 Secretariat, Budapest, Hungary.

BS 45 1 0: Methods for sampling cereals (as grain). British Standards Institution, 2 Park Street, London, U.K.

BS 4317: Part 18: Cereals and Pulses: determination of hidden insect infestation. British Standards Institution, 2 Park Street, London, U.K.

BS 6298 (= ISO 6644): Automatic sampling of cereals and milled cereal products by mechanical means. British Standards Institution, 2 Park Street, London, U.K.

Appendix II

1 Name and address of exporter

2

PHYTOSANITARY CERTIFICATE

No EEC / UK / E & W

3 Declared name and address of consignee

4 Plant Protection Organization of

GREAT BRITAIN

to plant Protection Organization(s) of

5 Place of origin

6 Declared means of conveyance

MINISTRY OF AGRICULTURE, FISHERIES AND FOOD

7 Declared point of entry

8 Distinguishing marks: number and description; name of produce botanical name of plants

9 Quantity declared

specimen

10 This is to certify that the plants or plant products described above
- have been inspected according to appropriate procedures, and
- are considered to be free from quarantine pests, and practically free from other injurious pests; and that they
- are considered to conform with the current phytosanitary regulations of the importing country.

11 Additional declaration

DISINFESTATION AND/OR DISINFECTION TREATMENT

12 Treatment

13 Chemical (active ingredient)

14 Duration and temperature

15 Concentration

16 Date

17 Additional information

Place of issue:

Date:

Name and signature of authorized officer:

Stamp of Organization:

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