Inspection Methodology for Plant Quarantine

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Abstract

Griffin, R. 1997. Inspection Methodology for Plant Quarantine. Arab J. Pl. Prot. 15(2): 140-143.

The inspection of agricultural products for import and export is widely recognized as an essential and fundamental tool for pest risk management in phytosanitary programs throughout the world. Quarantine actions, including the treatment or rejection of consignments, is routinely required by plant protection officials based on inspection findings. These actions can have significant impacts on trade and are open to the scrutiny of trading partners and international organizations such as the World Trade Organization (WTO) and the International Plant Protection Convention (IPPC). It is therefore incumbent upon phytosanitary authorities to be clear about the role of inspection in their programs in order to ensure that the methodologies they employ provide an appropriate level of protection and are also consistent with relevant principles of trade. The criteria used to determine whether inspection should be used, and how it is to be used, must be clear at the outset. The development and selection of appropriate methodologies then requires consideration of the pest risk in relation to the detectability of the pest and the practicality of inspection at some level of intensity. A number of technical and practical variables must be carefully evaluated and certain basic principles of statistics are employed for the design of sampling plans that are as fair as possible to trade while also maximising the efficacy of inspection as a pest risk management tool.

Introduction

Plant quarantine inspection personnel in every corner of the world are required to draw inferences about consignments based on the inspection of selected samples. Hundreds of decisions are made daily using a sample to represent the whole. Millions of dollars worth of agricultural commodities hang in the balance -- hostages to the decisions believed to have plant protection as their objective. What is the technical justification for using inspection as the basis for such decisions? How is the inspection methodology determined? What criteria are used to define acceptance or rejection? And, finally, how do we know if inspection is fairly applied in trade?

The need and right of countries to protect their plant resources is not disputed. But it is also clear that some risk must be accepted when trading commodities in international

commerce. Phytosanitary procedures such as inspection play a key role in determining the level of protection or risk that is accepted and how it is managed. This paper aims to promote analytical approaches to inspection resulting in the adoption of systems which link inspection to the level of pest risk and operational feasibility deemed to be acceptable and procedures that are both transparent and practical when using inspection for pest risk management. It also encourages the consistent application of such methods.

> *Inspect: Perform an official visual examination of plants, plant products, or regulated articles to determine if pests are present and/or to determine compliance with phytosanitary regulations (FAO, IPPC Glossary of Phytosanitary Terms - 1995)*

Scope

Inspection is a fundamental, essential, and substantial element of pest risk management in phytosanitary programs throughout the world. This is primarily because a high percentage of pests are visually detectable or their signs or symptoms are easily distinguishable. Accordingly, the results of inspection have traditionally provided critical information forming the basis for decisionmaking for phytosanitary purposes.

Inspection may be broadly interpreted to include a wide range of activities, processes, and methods employed for various reasons. For instance, the verification of documentation is an activity commonly associated with a phytosanitary inspection. Likewise, the examination of a site or facility for compliance or suitability under phytosanitary requirements may fall within the broad interpretation of inspection. Inspection may also be used to gather information or to monitor or audit phytosanitary programs. However, for purposes of the discussions herein, inspection is concerned solely with the activities performed for the detection of regulated pests in commodity consignments in order to determine compliance with phytosanitary requirements.

In this context, inspection is equally important for both the certification of exports and the clearance of imports, excluding personal shipments such as those encountered in passenger baggage. One reason for this is that inspection activities associated with passengers focus on the detection of items rather than the detection of pests. In addition, the objective of such inspections is not the rejection or acceptance of the entire lot (e.g., the conveyance), which is usually the case with commodity consignments.

Another important reason to focus on inspection in terms of its application to commodity consignments is that these are the component units of trade. Trade provides the background from which the need for technical justification arises in the contemporary global trade environment. Provisions of the Agreement on the Application of Sanitary and Phytosanitary Measures (SPS) of the World Trade Organization (WTO) as well as principles and standards developed under the International Plant Protection Convention (IPPC) establish the framework by which phytosanitary measures affecting trade are developed and challenged.

Trade considerations

Governments that are signatory to the WTO-SPS share the obligation to ensure that phytosanitary measures, including procedures such as inspection do not discriminate in an arbitrary or unjustified manner and are not considered to be a disguised restriction on international trade.

Because inspection plays such an important role in phytosanitary programs and may have profound effects on trade, it is inevitable that inspection will come under increasing scrutiny. As with other measures affecting trade, inspection must either conform with international standards established by the relevant standard-setting organization (the IPPC) or have a scientific basis. Since international standards for phytosanitary inspection are not yet in place, it is incumbent Members under the WTO-SPS to ensure that the inspection procedures they adopt have a scientifically sound basis.

Although the IPPC has plant protection as its objective rather than trade, the Convention clearly recognizes the need for phytosanitary measures to be technically justified and based on phytosanitary considerations. The IPPC has also adopted general and specific principles with particular relation to the application of phytosanitary measures in international trade. Guidance provided by these principles is useful for understanding obligations under both the WTO-SPS and the IPPC.

> *Managed risk - Because some risk of the introduction of a quarantine pest always exists, countries shall agree to a policy of risk management when formulating phytosanitary measures. (International Standards for Phytosanitary Measures: Principles of Plant Quarantine as Related to International Trade)*

To correctly understand and apply inspection, it is important for phytosanitary authorities to first recognize and accept that inspection is based on the concept of a tolerance associated with the probability of detection and consideration of the limitations of confidence.

For example, finding that two boxes of fruit from a total of ten are free of pests does not provide absolute assurance that all ten boxes are free of pests. There is some probability that pests occur in the remaining boxes and there is a degree of uncertainty (variability and error) associated with the two boxes that were inspected. The issues that must be addressed here are the level of tolerance and confidence which is acceptable.

Identifying the level of tolerance and confidence that is acceptable and the means for measuring the same is therefore essential for establishing the reference point from which inspection objectives and results are measured. These factors form the basis for emphasis on technical requirements, particularly the statistical concepts that are most appropriate to establish a pest risk basis for inspection.

A risk-based inspection is one which has as its objective a defined level of possible pest prevalence and a specific level of desired confidence. This is in contrast to an inspection which is based on non-transparent criteria (arbitrary or intuitive), or one that is designed solely for operational simplicity.

In the absence of a risk basis upon which to design inspection objectives, inspection becomes less transparent and more difficult to justify in phytosanitary terms. By applying sound statistical concepts and risk-based rationale to the development and selection of particular inspection programs, phytosanitary authorities are better able to measure and manage these risks in a consistent and justifiable fashion.

The development and adoption of risk-based inspection programmes also enhances the ability of phytosanitary authorities to establish priorities for their inspection resources and to design inspection programmes that are transparent for trading partners and the private sector. By establishing reference points (risk-based inspection objectives) and a means to measure the results, it becomes possible to identify, in an analytical and transparent manner, the areas where inspection resources are most needed and the level of resources required. These determinations then correspond with the acceptable level of risk and the strength of measures to be applied.

In the current global trading environment, governments are obliged to make their phytosanitary requirements available and may be called upon to explain the rationale for the requirements, including inspection. This is especially true when it is perceived that requirements have an overly adverse affect on trade. In such instances, it may be necessary to demonstrate that inspection is not being used in an arbitrary or unjustified manner, creating a barrier to trade.

It is essential for phytosanitary authorities to be able to rely on the risk-basis for inspection programmes as their justification and have the proper analytical criteria and information available for support. An inspection programme with risk-based objectives and a sound analytical background has a much greater chance of withstanding such scrutiny.

While it is generally agreed that inspection should not be used in an arbitrary and unjustified manner, it may be that this occurs, either intentionally or accidentally. Such situations are certainly subject to challenge and, hopefully, open for correction. The two disciplines that are most critical in this regard are pest risk analysis (PRA) and acceptance sampling (statistical sampling for discovery). The combined application of these disciplines provides the tools to determine whether inspection is the most appropriate phytosanitary procedure to use for managing pest risk and the characteristics of a proper inspection design.

Criteria for using inspection

The primary assumption behind the use of inspection is that the pests of concern are detectable. The organism and/or its signs or symptoms must be visually discernable and distinct enough to minimise the potential for confusion with non-pest organisms or conditions. Inspection should not be used as the sole basis for phytosanitary decisionmaking if the pests of concern are not detectable.

Another key assumption in inspection is that a certain amount of risk and uncertainty can be accepted. Under normal circumstances, an inspection is not done on 100 percent of a consignment, and an inspection cannot be considered to be 100 percent efficient. Since inspection is usually based on a sample and always involves a degree of uncertainty and variability, there will be some probability that pests will escape detection. Associated with this is a certain degree of confidence in the level of detection achieved using a prescribed level of inspection. The level of possible pest prevalence that is unlikely to be detected may be described as a threshold prevalence, allowable prevalence, or tolerance.

The acceptance of a tolerance and variability is inherent in the adoption of inspection as a phytosanitary procedure. For this reason, it is not appropriate to use inspection as the basis for phytosanitary decisionmaking if the objective is zero risk or absolute pest freedom. Further, it must be recognized that inspection cannot be properly used for pest risk management without having an understanding of the level of tolerance and variability that is associated with the procedure.

Statistical considerations

Historically, it has been common practice to specify that an inspection sample should be some fixed percentage of a lot -- for instance, 2 percent. This specification is based on the mistaken idea that the protection given by sampling schemes is constant if the ratio of sample size to lot size is constant. However, the laws of probability argue differently. It is important to understand this mathematical relationship and some fundamentals of sampling in order to identify the most statistically sound design for risk-based inspection.

Phytosanitary inspections are a form of discovery sampling. Discovery sampling is a type of acceptance sampling where samples are taken from a finite population without replacement and sampled lots are rejected if they are found to contain one or more "defects" (the characteristic

which is to be detected). In the case of phytosanitary inspection, acceptance pertains to regulated pests.

Where tolerance refers to the possible prevalence in the entire lot (all similar units of the commodity consignment), acceptance refers only to the sample. Under normal circumstances, the acceptance level for a phytosanitary inspection will be zero. This means that lots are rejected after a single regulated pest is found. Because a zero acceptance level in the sample does not correspond to zero prevalence in the consignment, some probability of infestation or contamination exists even if the sample is found to be pest free.

An acceptance level implies some tolerance in the lot according to the statistical relationship between the lot size, sample size, allowable prevalence, and confidence level. Typically, the lot size is not controlled by the inspection program, and the confidence will be some fixed value such as 95 percent. This leaves only the sample size and allowable prevalence to be managed under most circumstances.

The mathematical relationship between sample size and allowable prevalence is such that managing for a fixed sample size (such as a 2 percent sample) results in an allowable prevalence that fluctuates with changing lot sizes. Managing for a fixed prevalence results in larger or smaller sample sizes, again depending on the lot size. The proper design for inspection sampling will depend on whether the objective is a constant allowable prevalence or a constant sample size.

A risk-based inspection design will aim to manage for a constant level of allowable prevalence. This means that the maximum allowable prevalence would be a fixed value associated with a fixed confidence. The result is a sampling design where the sample size varies according to the lot size. For example, the inspection may be designed to have 95 percent confidence in the detection of a 10 percent contamination or infestation rate. In other words, an infestation or contamination rate of 10 percent or greater would be detected 95 percent of the time.

Proper mathematical modelling of this relationship is based on several assumptions: (i) sampling is done without replacement; (ii) sampling is random[1] and (iii) the population (lot) is finite

It is well known that sample size increases in a non-linear fashion as population increases. The result is that small lots must be sampled at proportionately higher rates than large lots. The hypergeometric distribution provides an appropriate model for calculating and demonstrating this relationship under the circumstances and assumptions described.

Conclusion

By employing these fundamental statistical principles in the development and evaluation of inspection programs, phytosanitary authorities are able to determine and/or establish the allowable prevalence corresponding to a level of pest risk deemed to be acceptable and an inspection regime deemed to be practical. This allows the inspection to be linked to pest risk analyses and makes it transparent for trading partners. Likewise, if used in a consistent fashion, it ensures that inspection is fairly applied against the objective for which it is intended -- pest risk management.

الملخص

جريفين، روبرت. 1997. طرق التفتيش المستخدمة في الحجر الزراعي. مجلة وقاية النبات العربية. 15(2): 140-143.

من المعترف به دوليا أن تفتيش المنتجات الزراعية المستوردة أو المصدرة هو أمر أساسي ووسيلة مهمة في برامج الحجر الزراعي لهدف تقليل خطر انتشار الآفات الزراعية. ان قرارات الحجر الزراعي بما فيها معالجة أو رفض الارساليات يتخذها عادة مسؤولي الحجر الزراعي بناء للنتائج المتحصل عليها من عملية التفتيش. هذه القرارات لها تأثير كبير على حركة التجارة، وهي مرشحة للمراجعة والتدقيق من قبل الفرقاء المتعاملين وكذلك من قبل منظمة التجارة العالمية وجهاز المعاهدة الدولية لوقاية النبات. لذلك من الضروري أن يكون واضحا للهيئات المسؤولة عن الحجر الزراعي ما هو دور التفتيش الزراعي في برامجهم للتأكد من أن الطرق المتبعة تفي بالحماية المطلوبة وبنفس الوقت تراعي المبادئ الأساسية للتجارة. كما أنه يجب أن تكون المعايير المستعملة في تحديد ما اذا كان من الضروري اجراء التفتيش أم لا وكذلك كيفية استخدامها واضحة منذ البداية. لذلك فان تطوير واختيار الطرق المناسبة تحتاج الأخذ بعين الاعتبار مدى خطورة الآفة ومدى سهولة الكشف عنها من الناحية العملية. كما يجب تقييم عدد من المتغيرات التقنية والعملية بدقة مع استخدام مبادئ الاحصاء الأساسية عند تصميم طرق أخذ العينات بحيث لاتكون مجحفة بالحركة التجارية وفي نفس الوقت ترفع من كفاءة التفتيش كوسيلة للحد من خطر انتشار الآفات.

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[1] True random sampling may not be practical for all phytosanitary inspections. However, maximum randomness should be an objective, recognizing that precision suffers as randomness declines.