

# Plant Inspection and Certification

The inspection and certification of plants, normally green plants, and any of their parts or products represent some of the most important aspects of regulatory plant protection, embodied in the application of any of the following principles: control and/or containment, eradication, and exclusion. Food and fiber are the vital mainstay of human existence and emanate, as clearly no other product, from plants in contributing to the health, welfare, and well-being of the human race—indeed to the existence of all forms of higher animals.

## Historical Aspects

At some time in the past, perhaps early in the course of human history, man began to realize that the simple act of moving plants or plant products from one place to another was causing problems for himself and his neighbors. In some instances, the plants or products were unfit for use on arrival at their destination or shortly thereafter. At other times, new disorders of growing crops appeared after movement of plants. When man became aware that often these problems were caused by unwanted organisms accompanying the plants, he began to examine his products before moving them and, more critically, to examine those items received from other areas. Although the time and place of the beginnings of the process of plant inspection are not recorded, it is evident that awareness of the plant pest problem and the inspection of plants began long before governmental regulation of plant movement.

As the causal agents of plant diseases and related problems became better known, various techniques for crop protection were developed, including pest-resistant plants; chemical, cultural, and biological control; and plant quarantines.

In a broad interpretation, a plant quarantine may be defined as any action initiated with the intent to prevent or restrict the introduction, establishment, or dissemination of an unwanted organism to a new noninfested location. The earliest semblance of quarantine restrictions dates back to the latter half of the fourteenth century in the Mediterranean area, followed by a ship detention system established by Venice in 1403 and similar measures by Genoa in 1467 (11). The first formal laws based primarily on this concept appeared during the nineteenth century. As early examples, Germany enacted a law in 1873 to prevent establishment of grape phylloxera and in 1875 prohibited importation of Irish potatoes from the United States to prevent introduction of the Colorado potato beetle into Germany. Other European countries, notably England, France, and Denmark, passed similar legislation during the next several years. During the same general time span, various states of the United States initiated plant quarantine measures. California's first law granting quarantine authority was passed in 1881. This act provided for appointment of plant inspectors. By 1908, all but nine states had enacted plant quarantine legislation. Some federal participation began in 1912 with passage of the Plant Quarantine Act.

## Plant Protection Agencies and Their Functions

**Federal.** At the present time, virtually all nations and their political subdivisions have established plant quarantine laws and organizations for their enforcement. Implementation of federal plant protection and quarantine programs of the United States is the responsibility of the U.S. Department of Agriculture's Animal and Plant Health Inspection Service (APHIS). A principal function of this agency is to protect the nation against entry of foreign plant and animal pests.

This is largely accomplished by inspection at ports of entry of incoming baggage, cargo, stores, and mail for prohibited plants, fruits, or vegetables as well as meat and milk products that may be harboring pests.

In spite of the effort expended by the USDA to exclude pests at ports of entry, problems abound in accomplishing this objective. There is always the traveler who sees some exotic plant, fruit, etc., that he feels he must take home with him. For example, the voracious plant-feeding giant African snail (Fig. 1) a young boy carried in his pocket to his home in Miami resulted in a serious infestation. Some take great pains in carrying or smuggling the item or items past the port inspector. With the enormous amount of travel taking place all over the world, the sheer number of travelers makes it virtually impossible for port inspectors to detect and confiscate all prohibited articles or smuggled contraband.

Travel to various and easily accessible places outside the country by private plane or yacht presents additional problems. In Florida particularly, immigrants, both legal and illegal, carry or smuggle prohibited materials into the state.

Unfortunately, it also appears that at least some members of the research community are so intent on introducing new material for scientific research purposes that they either unknowingly introduce without obtaining proper entry permits or deliberately bring or cause to be introduced prohibited material into the state in violation of the plant protection laws, thereby jeopardizing agriculture. There are no proven instances where researchers have intentionally introduced pests into the country, but circumstantial evidence tends to support these practices.

In some instances through agreement with foreign exporters, federal inspectors are sent to exporting countries to give

preshipment clearance to plants or other products destined for the United States. Another important function of the federal service is to provide inspection and certification of plants for export to foreign countries, with the close collaboration of inspection personnel of various states, as is conducted in Florida (Fig. 2).

The success of these efforts to exclude foreign pests can be demonstrated abundantly by statistics on the interceptions of serious plant pests that have not become established or whose establishment has been delayed. Pests that manage to evade quarantine barriers often become established in the vicinity of ports of entry. A study of this matter in the late 1970s indicated that over 90% of foreign pests introduced in the United States since 1912 were found within 100 miles of ports or border areas (1), and prior to 1912, fully half of all the injurious insects in the United States were of foreign origin (12). Recognizing the importance of early detection of introduced pests, APHIS, in 1977, began a program referred to as "high-hazard" survey around 16 major

U.S. ports and border stations. Emphasis was placed on inspection of major crops and home gardens. In 1978, this program was supplemented by a plant disease survey in nine north central states. These programs were in addition to an ongoing cooperative plant pest survey which, in 1979, operated under agreement with 39 participating states. A recent summary of pest detection for the 1979 calendar year in the United States lists 11 new U.S. records and 91 various distribution records (6).

**State.** While the role of the U.S. Department of Agriculture in plant protection is nationally oriented, similar organizations in the states are primarily concerned with domestic plant problems, particularly those that are peculiar to, or confined to, a specific state or region. State programs are often designed to perform quarantine functions in circumstances where federal programs are not available or applicable. In many instances, state programs are designed to operate in cooperation with federal programs. The plant protection efforts of individual states tend to vary in

proportion to the value and extent of the state's agricultural economy and its vulnerability to pest invasion.

Although there is considerable variation in the structure and size of state plant protection organizations, the majority of states have specialized agencies within their agriculture departments that are responsible for plant inspection and related functions. Florida follows this general pattern and will be used as an example in the discussion of plant inspection and certification at the state level. Plant protection is particularly important to Florida, which in 1979 had a farm income of \$3.89 billion and annual sales of greenhouse and nursery products of \$298 million (7).

### Procedures in Florida

The basic state organization in Florida dealing with all phases of agriculture is the Florida Department of Agriculture and Consumer Services, headed by the commissioner of agriculture, an elected official and a member of the state cabinet. The department's Division of Plant Industry (DPI) is the regulatory agency responsible for implementation of laws, rules, regulations, and various programs pertaining to plants and plant pests. The DPI, headed by a division director, is subdivided into bureaus of apiary inspection, entomology, plant pathology, nematology, methods development, pest eradication and control, citrus budwood registration, and plant inspection. The latter bureau is responsible primarily for inspection and certification of plant material and for survey and detection of plant pests.

Headed by a bureau chief with headquarters staff, the Bureau of Plant Inspection has a field force deployed in three geographic regions throughout the state. Within the three regions are a total of nine areas, each with an area supervisor whose responsibility covers seven or eight districts, the basic work units of the bureau. The plant specialist in charge of each district is responsible for pest survey and detection, nursery stock inspection, and other related activities.

In addition to this basic structure, the bureau employs nine specialists whose principal assignment is to carry out a continuing census of commercial citrus acreage in the state, which totaled 845,283 acres at the end of August 1980 (4). The census, a state-federal cooperative program, involves the use of aerial photography and follow-up inspections by roving citrus specialists. These specialists conduct surveys for pests in conjunction with their normal work with the citrus tree census. They also make periodic pest surveys in subtropical fruit plantings (eg, avocado, mango), as well as other crops.

Another team of seven specialists is employed primarily in selecting citrus nursery sites and certifying citrus nursery



**Fig. 1.** The giant African snail (*Achatina fulica* Bowdich) was recently eradicated in Florida. A young boy had carried this voracious plant-feeder in his pocket to his home in Miami.



**Fig. 2.** Celery in Florida is inspected in the field and certified by a state plant inspector before harvest for export shipment.



**Fig. 3.** Container-grown nursery stock for export to other states or for intrastate movement is subject to inspection by Florida plant inspectors.



stock grown for shipment to commercial citrus groves within the state and other nursery stock grown for shipment to destination states or countries having certification requirements pertaining to nematodes. The major functions of the plant inspection bureau are concerned with import inspection, export inspection, certification for domestic and foreign plant movement, and pest survey and detection within state borders.

**Inspection of plants on arrival.** Since exclusion of plant pests has always been the best of all possible solutions to pest problems, considerable emphasis is placed on inspection of plants entering the state. As a major importer of nursery stock from foreign countries, Florida is particularly vulnerable to plant pest introduction. Its extensive agricultural industry and its broad range of climatic conditions provide an ideal environment for establishment of new plant pests. Entry of pests is facilitated by the large tourist industry, the numerous highways leading into the state, and the seven major seaports and airports. A recent report indicates that in 1979 the USDA plant inspection station at Miami, alone, processed the entry of more than 120 million foreign plants representing over 75% of all plants imported through the 14 federal plant inspection stations in the United States (2).

The first line of defense against pest introduction is of a regulatory nature. Both state and federal agencies have established a formidable array of quarantines that prohibit or restrict entry of certain species of plants depending, in some cases, on origin. Some degree of protection stems from the fact that federal regulations require enterable plants of foreign origin to be inspected and certified by the inspection service of the country of origin. Most states, including Florida, have similar requirements pertaining to plants originating in other states. Since the degree of confidence that can be placed in certificates of inspection varies greatly with the procedures of the certifying agency, inspection of imported plants at their destination has become general practice. Plants from states with pest problems of particular concern to Florida are inspected by state inspectors at the premises of the recipients of shipments.

**Postentry quarantine.** All foreign plant imports, except those with preshipment clearance, are inspected by APHIS personnel at ports of entry and released to importers when entry requirements are met. Certain species of plants whose entry would otherwise be prohibited are released to importers under an agreement that the plants will be held under postentry quarantine and grown at an approved site for a specified period of time (1 year for most species), during which the plants are periodically inspected and released only if found to be

free from plant diseases and other pests. State inspectors approve growing-site locations and conduct inspections required under postentry quarantine agreements. In 1980, state inspectors in Florida made 557 postentry quarantine inspections (10) before ultimate disposition of the plant material.

**Pest detection and survey.** An additional opportunity for detection of foreign plant pests is sometimes provided after plants have been released to importers. Florida's DPI requires registration of all nurseries (as well as stock dealers, agents, and plant brokers) and conducts inspections of nursery stock several times a year. Inspection of imported plants in nurseries substantially increases the probability of intercepting or detecting a serious pest before it becomes established or widely distributed. This procedure applies to plant shipments from other states as well as to those entering from foreign sources. The exclusion and detection of pests from other states are further enhanced by the plant protection branch of APHIS, responsible for domestic programs. This agency's efforts are directed toward containment or control of established pests of limited distribution, such as the citrus blackfly, golden nematode, imported fire ant, and other pests of national and interstate significance. Federal domestic programs are often cooperative programs with state agencies and may involve quarantines, surveys, eradication efforts, pest management techniques, or any combination of these. Most states have similar programs designed for exclusion or containment of pests of particular concern to the state's agricultural interests. Florida, for example, has special quarantine regulations pertaining to pests of citrus, orchids, sugarcane, and palms and other pests of particular significance to the agricultural economy of the state.

Since state plant inspection stations are not generally comparable to federal stations through which incoming plant material can be directed, most states rely primarily on regulatory measures and survey procedures for protection against plant pests from other states. State border inspections of plants are generally impractical. Florida, however, has limited highway entry points into the peninsula, so an effective inspection system on the entry of all commercial shipments of plant material is possible. Road guards notify the DPI of all plant material passing through the entry stations. Plant material not properly certified can be refused entry. When notified of the entry of plant material, the DPI can determine if inspection at destination is necessary.

The limitations of the effectiveness of plant inspection and certification requirements in preventing pest introductions have led to establishment of

various survey programs aimed at early detection of introduced pests that have become established when exclusion and interception have failed. Fortunately, because of biological factors, only a minute percentage of border-crossing pests are able to gain a foothold in their new environment. Early detection of those that do become established provides an opportunity to attempt eradication, containment, or management with considerably greater probability of success than would be possible if the pests were discovered after becoming firmly entrenched and widely distributed.

The DPI began an urban pest survey program in the Miami area in 1977. This program was initially conducted on a cooperative basis in conjunction with the USDA's high-hazard survey around major ports of entry. Subsequently, the survey was expanded by state inspection personnel to include all urban and some nonurban areas in the state. In addition to this program, pest surveys are made at nurseries, nursery environs, properties on which fruit fly detection traps are located, and other miscellaneous sites. The nurseries and dealers in nursery stock in the state are rated according to risk of pest introduction via plant imports, and higher priority is given to inspection of high-risk nurseries.

**Export inspection and certification.** While inspection of nursery stock contributes to the pest detection process, its major function is to provide the basis for certification of plants for export or movement from their growing sites. Plant certificates essentially are documents asserting that plant shipment requirements of the receiver have been satisfied. They may consist of a general statement of compliance or may include specific statements attesting to the absence of pests, to treatments applied, or to other conditions specified by regulations of the receiving country or state. Certificates, most commonly, are issued on the basis of plant inspection and are generally referred to as inspection certificates (tags) or phytosanitary certificates.

The format of certification used on nursery stock in interstate plant movement varies from state to state. By agreement, some countries, including the United States, have adopted a standard model for the phytosanitary certificate. The wording of the present international certificate used by the USDA is as follows: "This is to certify that the plants, parts of plants or plant products described below, or representative samples of them, were thoroughly examined on the date shown above by an authorized representative of the Plant Protection and Quarantine Programs, Animal and Plant Health Inspection Service, United States Department of Agriculture, and were found, to the best of his knowledge, to be substantially free from injurious diseases and pests; and

that the consignment is believed to conform with the current phytosanitary regulations of the importing country both as stated in the additional declaration hereon and otherwise."

Some foreign countries will accept only federal phytosanitary certificates, whereas others will accept state certificates provided, in most cases, that the form of the state certificate conforms with the international model. Plant shipments not

meeting certification requirements may be refused entry or otherwise jeopardized at their destination. Considering the economic losses that may be incurred by improper certification, the importance of export certification is readily discernible. Issuing agencies require and provide special training for personnel issuing certificates to ensure the high qualifications necessary to carry out this important responsibility.

Federal certificates may be issued by either APHIS or state personnel who have received special export certification training. The basic requirements for state personnel authorized to issue federal certificates are: 1) a bachelor's degree in the biological sciences, 2) a minimum of 2 years of experience in state phytosanitary inspection and certification, and 3) 2 years of experience in recognizing insects and plant diseases known to occur within their respective state, plus a general knowledge of plant pests occurring throughout the United States. Eight years of experience may be substituted for the degree in some cases. State certificates may be issued by state specialists having a college degree and appropriate specialized training.

In Florida, the majority of plant shipments cleared for foreign export by federal personnel are inspected and certified at port sites. Shipments handled by state personnel are inspected and certified at nurseries and other growing sites. During the 1979 fiscal year, federal inspectors issued 4,864 export certificates at the principal port in Miami (2). During the 1979-1980 fiscal year, state inspectors in Florida issued 885 federal and 10,249 state phytosanitary certificates for export shipments (10).

**Inspections and certifications for domestic shipments.** Plants for export to other states or for intrastate movement are inspected by state personnel (Fig. 3). State nursery inspection certificates, which are acceptable for interstate shipments, are issued to nurseries for use on shipments of nursery stock that has met certification requirements. Except in special instances, inspection of individual shipments originating at registered nurseries under regular inspection is not generally required for intrastate or interstate plant movement. Inspectors in Florida made 19,979 inspections of nurseries during 1979-1980 (10).

A number of states have regulations that require certification of cut flowers, bulbs, vegetable plants, turfgrass, and other miscellaneous items not generally classified as nursery stock in Florida. Inspections necessary for compliance with these regulations are generally performed by the state inspection service. Either federal or state inspectors may be involved in special certifications required for the movement of plant materials from an area under quarantine because of a specific plant pest. In general, federal

inspectors are responsible for certification of plants that are regulated under federal domestic quarantines, whereas state inspectors provide certifications required by intrastate quarantines or by regulations of other states pertaining to pests not covered by federal regulations. An example of the latter is Florida's regulations regarding the lethal yellowing disease of coconut palm that restrict movement of certain palms from a regulated area to other parts of the state and to other states with regulations pertaining to the lethal yellowing disease.

**Miscellaneous inspections and certifications.** Most plant inspection activity is primarily concerned with detecting plant pests; however, state inspectors are sometimes called on to make inspections for various other purposes, such as diagnosing plant problems (pathogenic, physiological, etc.), determining plant viability, and evaluating the quality or condition of plants. Investigations of consumer complaints regarding plants are usually performed by personnel of state agencies concerned with consumer protection and in some instances involve plant inspection.

Certifications are usually made in conjunction with direct plant inspections but in many cases require monitoring of compliance agreements, witnessing treatments, determining the absence of certain pests in the area, or other activities supplemental to plant inspection.

## Evaluation of Plant Inspection

A precise assessment of the results achieved by plant inspection and certification is difficult because there is no adequate method for determining the quantity of plant pests that have been disseminated by means of certified plants, nor is there an accurate way to estimate the number of pests that might have become established if no inspections were made. We can, however, gain a reasonable perception of the value of the process by examining the lists of foreign pests established in the United States before quarantine measures were established and by observing the serious and costly effects of known pest introductions that bypassed the established procedures.

Although all entries of foreign pests do not result in establishment of the pests, the value of import inspections and detection surveys is indicated to some degree by the number of pests detected or intercepted by the plant inspection agencies. For example, in 1979 APHIS intercepted 9,556 plant pests at U.S. ports of entry (5), many of which are considered very serious. State inspectors in Florida detected 23 insects, diseases, and other plant pests new to the state during the 1979 calendar year. These included four United States records and 19 state records (Division of Plant Industry Records, Bureaus of Plant Pathology and Entomology, Florida

Department of Agriculture and Consumer Services, Gainesville 32602). These data attest to the significance of and the necessity for an effective, professional organization of plant protection personnel.

### **Problems Related to Plant Inspection and Certification**

Although it is generally recognized that plant inspection and certification procedures have resulted in greatly reducing the movement of plant pests, resistance to the establishment and implementation of regulatory measures is sometimes encountered. Pressures of the profit motive often tend to obscure the long-range benefits of regulations that may directly affect the few for the ultimate and greater protection of our society and its agricultural resources. This problem has no final solution, but it is imperative that regulatory agencies devise and apply their mandates with a philosophy of providing maximum protection of agriculture with the least possible inconvenience or disruption of commerce.

At the international level, conflicts of interest frequently occur between plant protection goals and the objectives of those concerned with tourism, trade balances, international goodwill, or power politics. In matters of this sort, plant protection organizations must rely

largely on the sound presentation of biological facts supporting their objectives with the hope that a reasonable proposal will influence and enlighten those who will be affected by regulations and their political representatives whose decisions are likely to determine the course of events.

Assuming that appropriate regulations are established and compliance is satisfactory, the problem of pest detection by visual inspection is hampered by a built-in dilemma. The inherent limitations of human vision impose a barrier to the detection of many pests, particularly internal pests, such as viruses, bacteria, and other organisms of microscopic dimensions that plants, often symptomless, may be harboring. This problem may be countered to some degree by modern laboratory facilities and equipment such as microscopes, infrared and X-ray equipment, and other devices that enhance or supplement the visual inspection process, along with trained technical personnel.

The other side of this question is the problem of determining and evaluating the organisms detected. The practical impossibility of excluding all extraneous organisms found on plants in transit makes it necessary, without undue delay, to identify organisms, evaluate their economic significance, and determine what regulatory action, if any, should be taken. These processes require consider-

able special knowledge and judgment on the part of the plant inspector and his supportive staff. Agencies responsible for plant inspection services have become increasingly aware that the problem of deploying a capable plant inspector does not end with his appointment to a position, since most university curricula offer few courses, if any, specifically designed for the needs of the plant regulatory profession. Most agencies have found it necessary to establish their own training programs for plant inspection personnel. Florida's DPI, for example, conducts a 6-week intensive training course for all new personnel and provides frequent workshops, seminars, and other in-service training under the direction of a training coordinator.

Continuing education and training are essential for front-line inspectors but would be inadequate without a capable support staff of administrative and technical personnel, including specialists in taxonomy, pest management, and other disciplines related to plant protection work. In some states, staff services are provided by the regulatory agency itself or by personnel of the state university system or other agencies. In Florida, technical support for field operations is provided by its bureaus of entomology, nematology, plant pathology, and methods development working in conjunction with the plant inspection bureau. A bureau of pest eradication and

control assumes the responsibility for pest situations involving eradication, suppression, or other pest management functions.

In some states, Florida notable among them, sheer volume of plant movement poses a major problem for the state and federal inspection services. The burgeoning of the nursery business in Florida during the past decade has placed a severe strain on the manpower resources of the agencies responsible for plant inspection and certification. Besides receiving a large percentage of the foreign plants imported in the United States, Florida supplies approximately 80% of the foliage plants sold in the country (2) and it has over 9,000 nursery locations as well as 5,000 nursery stock dealers within its borders, with a total plant inventory of over 300 million (10). To meet the inspection and certification needs and demands generated by a growing nursery industry and an ever-rising tide of imports, state and federal agencies have responded by restructuring their organizations, modifying procedures, and augmenting inspection forces when possible. Maintaining an adequate staff has become a problem in Florida and other states with an expanding agricultural industry.

Because of the nature of publicly supported organizations, government agencies are usually unable to increase

staffing as rapidly as private enterprise is capable of expanding. This inevitably leads to a widening gap between the agencies' capabilities and plant industry's need for services. Systems involving industry fees for plant inspection services have failed to provide adequate support in most instances. Agencies attempting to improve efficiency by upgrading the quality of personnel are often frustrated by funding inadequate to attract and retain highly qualified and experienced personnel. A high rate of personnel turnover is detrimental to the efficacy of operations, costly to the taxpayer, and clearly indicative of a need for strong efforts to alleviate the problem.

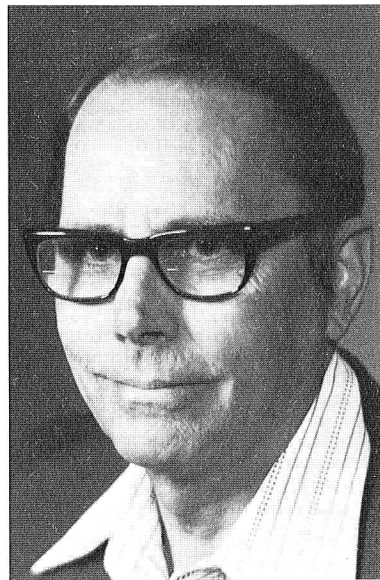
Concurrent with problems encountered in the plant inspection process are those concerning certification. Determination of the importer's requirements, the first step in certification, is not always an easy task for the inspector in the field. Regulations of the various states and foreign countries are constantly changing, often issued without notice or with inadequate notification. In some instances, the meaning of a regulation may be unclear or misconstrued in translation or interpretation. Fortunately, as a guide through a forest of regulations, the USDA has compiled summaries of import regulations of all states and nations, which provide information that helps to minimize the degree of

confusion. These summaries are highly useful but may be misleading at times because of unrecorded changes or misinterpretations. Countries sometimes issue to shippers import permits specifying contradictory or additional conditions for certifications that do not appear in summaries. If the permits are not available to the certifying official, as often happens, errors may occur. Shippers occasionally advise inspectors that they have received special permission to export prohibited or restricted items but are unable to produce documentation acceptable to the certifying agency. A letter from the king's gardener or a phone call from the shipper's broker are examples of unacceptable permits. Shippers, through error or deliberation, sometimes misuse certificates by placing them on shipments for which they were not issued. On other occasions, certificates are lost in transit or shipments are dispatched without certification or unaccompanied by the required certificates. Maintenance of the identity of shipments with their appropriate certificates is often difficult when plants from various sources are mixed in carriers. Whatever their origin, problems with certification that are likely to result in delay or loss of shipments are usually referred to the inspector at the shipping point for resolution. His handling of these situations with expertise and good



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judgment will, in most cases, enhance the credibility of the certification procedures of his organization.

## The Stakes Are High

Despite the problems and seeming imperfections, plant inspection procedures are of proven value and are certain to continue to serve as the principal methods of regulatory organizations charged with protection of agriculture by deterring the spread of serious plant pests. The stakes are remarkably high. The value of U.S. agricultural exports alone reached \$40 billion in 1980 (3). It has been estimated that nearly one-third of all agricultural products are destroyed by insects alone before reaching the market (9). Losses due to plant diseases are equally devastating, ranging from 10 to 100%.

If we assume that the world's population will continue to increase as it has in the past, then mankind's dependence on agriculture for food will continue to increase. It has been said that crop productivity must increase 100% in the next 25 years to supply the food and fiber needs of a growing world population (8). In a world of persistent hunger, where population growth threatens to outstrip agricultural production, it would appear that the plant inspector will play an increasingly responsible role in safeguarding the future of agriculture.

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