

Exporting fruit from low fruit fly prevalence zones with a multiple mitigation systems approach

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Abstract

With the increase emphasis on trade of fresh fruits and vegetables worldwide, systems approaches have become part of an international effort to reduce risk of establishing new pests while providing a biological basis to risk assessment. Area-wide pest management programs have been shown to be successful in many demonstration programs worldwide. However their utility in actual practice ranges from successful to unsuccessful depending on the focus of the program and the desired milestones of the program. Area-wide programs might also be used in export programs as part of an overall "systems approach" to quarantine security thus allowing for the movement of commodities from one area to another. Systems approaches, like area-wide pest management, are concepts developed and implemented from research whereby multiple actions are cumulatively are more successful than any single tactic alone.

Key words: Integrated pest management, Area-wide integrated pest management, systems approaches, trade, quarantine, risk.

Introduction

World trade in agricultural commodities

Worldwide, agricultural production and trade is increasing, both in importance as part of the GNP of many developing countries as well as an increasing interest by developed countries for new agricultural products. This is occurring in spite of increasing pressure to mitigate the threat of invasive pests and maintain country sovereignty on trade issues involving plant and animal health as agreed to by participating countries under the General Agreement on Tariffs and Trade (GATT) and subsequently the World Trade Organization (WTO). Other factors that impact on trade in agricultural commodities include global climate change and the changing landscape ecology of forest and agricultural land, sustainability of existing agricultural lands, water availability and pesticides in the environment. Such concerns worldwide have spawned various international meetings on these topics and in some cases agreements between countries which impacts agricultural trade. These agreements have spawned the term "harmonization" to refer to the trend towards global agreements, standard terminology and methods that form the "framework" for issues of common concern. Pest incursions, invasive species and agricultural quarantines have increasingly become important topics at regional, national and international

meetings due to their impact on agriculture as well as overall concerns on global biosecurity.

Pest risk assessments

In order to properly assess the threat of pests on agricultural commodities, many countries initiate "pest risk assessment" as a method of determining the relative risk of a potential pest introduction in agricultural production and marketing systems. If the pest is known to or has a high potential to do harm if established, the pest is usually identified as a quarantine pest. Pest risk analysis is the basis for the identification and mitigation of phytosanitary issues internationally and has been agreed upon and codified by countries at international meetings such as the International Plant Protection Convention (IPPC, 1997). This meeting included most of the signatory members of WTO. Within IPPC a committee was established to develop International Standards on Phytosanitary Measures (ISPM) under the IPPC whose main purpose was to harmonize phytosanitary issues. At least 21 guidelines have been identified as ISPMs under the IPPC. Further information can be found at www.ippc.int

Mitigation of pest risk

Mitigation of pest risk is universally the responsibility of the importing country as a requirement for allowing imports into a country. Mitigation of pest risk can include many forms including the designation of area freedom of the pests of concern, pest free production periods, specific quarantine treatment measures such as fumigation, heat and cold treatments, and irradiation, exclusion of pests in approved structures such as quarantine greenhouses and multiple mitigation systems approaches that will cumulatively reduce the risk of pests in commodities and/or becoming established in areas where the pest does not exist. In this paper we will discuss the use of multiple mitigation procedures often referred to as "systems approaches" as one method for ensuring that the likelihood of pest introductions are minimized. We will discuss the importance of area-wide pest management in overall risk reduction and give some examples of how systems approaches have been successfully used to mitigate risk of highly invasive tephritid fruit fly pests.

Systems approaches to Quarantine security

The application of systems approaches for mitigating pest risk is not a new concept but has gained popularity over the last 20-30 years as the need for biologically-based decision making for determining pest risk has increased and the need for alternatives to single treatments based on such analysis increased. Although single treatments are still important, the removal of effective fumigants such as ethylene dibromide and methyl bromide, postharvest damage and/or quality issues and the costs of such treatments have increased interest in other mitigation procedures. Systems approaches can be defined as "the integration of those pre and postharvest practices used in production, harvest, packing and distribution of a commodity which cumulatively meet the requirements of quarantine security" (Jang and Moffitt, 1994). More recently the IPPC has defined systems approaches as "the integration of different pest management measures, at least two of which act independently, and which cumulatively achieve the appropriate level of phytosanitary protection" (ISPM Pub. No. 14, 2002)

Systems approaches differ from single quarantine treatments in that multiple actions are utilized that cumulatively reduce the risk of pest establishment. Systems approaches integrate biological, physical and operational factors that affect the pest's biology in such a way that the likelihood of establishment can meet the requirements of the importing country. Systems approaches have been codified as ISPM Pub. No 14: The use of integrated measures in a systems approach for pest risk management (Quinlan, 2004)

Systems components

Figure 1 shows an example of how a systems approach could be applied to a single crop that targets a quarantine pest. Components of a systems approach can vary widely but in general start with identification of the pest(s) of concern, knowledge of the basic biology of the pest including the pest/host relationship, dispersal, alternate hosts, habitat and population dynamics. Often a method for detection and surveillance of the pest can be useful in identifying the pest population as well as determining "pest incidence thresholds" (PITs). Other components of a system can include postharvest practices, packing and marketing of products and regulatory aspects such as phytosanitary certifications by importing and exporting countries [under specific compliance agreements]. Systems approaches are generally more difficult to manage than single post-harvest treatments (Liquido et al 1997), however systems approaches have been implemented widely in recent years in the US and is rapidly gaining widespread acceptance internationally.

Integrated pest management (IPM) and Area-wide Integrated pest management (AWIPM)

Control of insect pests in the field has always been a cornerstone in production agriculture. Integrated pest management (IPM) utilizes multiple tactic methods based on sound biological information about the pest to control population below economic threshold levels. IPM has become more widespread as the availability of single tools (e.g. pesticides) to combat pest become more limited, resistance has become more of a problem with some pests and an increase in organic farming has required the application of alternative control measures. IPM relies on biologically based management decision-making [surveys, ecology etc] versus calendar decision making (e.g. weekly chemical sprays) and thus encourages management rather than complete eradication of a pest species. IPM takes advantage of all available control measures, (biological, chemical, cultural, etc) and aims at ensuring long term sustainability in agricultural practices.

Area-wide integrated pest management (AWIPM) is an important part of integrated pest management approaches, especially in cases where specific pest species are not easily controlled on a single crop or farm-by-farm basis. Pests with wide host ranges are more likely to be controlled using an area-wide approach than individually. This is the case with tephritid fruit flies in Hawaii where multiple hosts including both cultivated and non cultivated hosts exist and there is a year-round growing season consisting of multiple generations per year (see Vargas et al. this issue).

AWIPM can be compatible with systems approaches to quarantine security by lowering pest incidence at the production stage thereby reducing the risk that pest will be present in the "pathway" leading to export. In the past, single quarantine treatments assumed a "worst-case scenario" in regards to pest levels and treatments were designed to kill a high proportion (99.9968%) of individuals ("probit 9" mortality Baker 1939), although in many cases such high infestation levels did not exist, especially in well managed operations. By reducing the pest population level early in the "production-to-market" pathway, other pest management strategies that would not meet the high efficacy demands of probit 9 mortality could be used in conjunction with other independent methods that would cumulatively reduce the risk of infestation to acceptable levels.

A partial list of pre and postharvest mitigations that could be used in a systems approach is show below:

Preharvest and field mitigations

- ✗ Field monitoring and detection to determine pest population levels which may include
- ✗ Trapping, sweep net assessments, surveys, fruit sampling, fruit cutting, other triggers
- ✗ Field treatments that may include bait/cover sprays, fruit stripping/ground treatments, fruit bagging, SIT, biocontrol
- ✗ Other field mitigations such as secondary host free, resistant cultivars, pest free growing structure, pest free growing season, altitude/area restrictions

Postharvest mitigations (other than treatment)

- Safeguarding (harvest-pack-export)
- Inspections/faults (importing & exporting)
- Fruit cutting (importing & exporting)
- Production seasons
- Shipment size/ type/ports of entry
- Maturity indices (e.g. ¼ ripe or less)
- Permits, audits, labeling, compliance

Development of export quarantine strategies

Export marketing often requires approvals of regulatory bodies such as state and federal agencies responsible for allowing imported commodities into a region or country. These bodies can also be party to large regional organizations (North American Plant Protection Organization (NAPPO)) or international bodies (WTO) that harmonize procedures for phytosanitary approval and clearance of agricultural commodities. Most countries have national plant protection agencies (USDA-APHIS, NZ- MAFF, AQUIS, etc) that are responsible for regulating international trade coming into their countries. Regional bodies such as states within countries also have policies and procedures that may be more rigorous than national standards. These organizations will often require one or more of the following information in order to allow commodities into their areas

- ✗ Identification of fruit fly pests by importing National plant protection organization
- ✗ Design proposed mitigation procedures
- ✗ Cost/benefit assessment
- ✗ Document effectiveness of mitigation

- ✍ Trapping data use international standards.
- ✍ Publications/reports of effectiveness of mitigation
- ✍ Field test of system
- ✍ Pest Risk assessment (PRA)
- ✍ Mitigation of other pests in PRA
- ✍ Written proposal/work plan

Work plans and proposals are often rigorous and require multiple inputs from the exporting entity and verification/compliance by the importing authorities prior to testing and subsequent approval. Normally the burden of proof lies with the exporter to show that their crops is and can be certified as meeting the risk levels of the importing country.

An example of a systems approach incorporating preharvest mitigations for allowing papaya into the US is shown below (USDA 7CFR 319.56-2W)

- ✍ The commodity is papaya (*Carica papaya* L.) to the US (from specified areas)
- ✍ The pest is the Mediterranean fruit fly, *Ceratitis capitata* (Medfly)
- ✍ Major mitigation measures:
 - ✍ poor host,
 - ✍ low prevalence,
 - ✍ specific cultivars,
 - ✍ specific maturity stage,
 - ✍ hot water dip
- ✍ Phytosanitary/compliance/audits

Specific mitigation measures

- Only 'solo' type papaya shipped into the continental US (not Hawaii) from identified countries and growing areas
- 30 days prior to harvest fields must be kept free of papayas ½ ripe or more, all culls and fallen fruit must be removed from field
- Hot water dip of harvested papayas for 20 min at 49 degrees C.
- Only papayas less than ½ ripe and free from insect pests packed
- Papayas safeguarded from exposure to fruit flies from harvest to export. No other fruit in consignment, signage (not for sale in Hawaii)
- All shipments to contain phytosanitary certificate from national Ministry of Agriculture under compliance agreement
- Beginning 1 year before harvest through completion of harvest fruit fly traps maintained in fields
 - ✍ 1 trap/hectare checked weekly by Ministry
 - ✍ 50% McPhail trap and 50% Jackson trap
 - ✍ Trigger: 7 medflies/trap/week – control measures must be initiated if > 7 F/T/W > 14 Flies/trap/week no importation from area until < 7 flies/trap/week in area.

Other mitigation procedures may be implemented if the importing agency deems it necessary to reduce pest risk to an appropriate level. Exporter as advised to contact their international trade office for specific requirements as these often change.

Conclusion

Pre and postharvest pest management is critical for the development of systems approaches to quarantine security against invasive pests and diseases. Integrated pest management (IPM) and area-wide integrated pest management (AWIPM) approaches can be incorporated into systems approaches thereby reducing the risk of pests being present postharvest and through multiple independent mitigation procedures further reducing the likelihood of pests entering areas where they are not established. There are several examples of how AWIPM can be used in systems approaches and those involved in fruit flies integrate several control tactics over a large area such as detection and surveillance, trapping, in field control using bait sprays, cultural practices such as in field sanitation, the use of sterile insect releases (SIT) and host status, host phenology and specific cultivars in some cases.

Continued research and development is needed to improve both IPM and AWIPM approaches as it relates to systems approaches as well as better understanding of the biology and ecology of fruit flies and other pests. Policy makers are needed to identify levels of risk that ensure biosecurity of its borders while facilitating trade of agricultural crops. This is especially urgent as agricultural trade increases worldwide and invasive quarantine pests continue to spread.

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Systems components

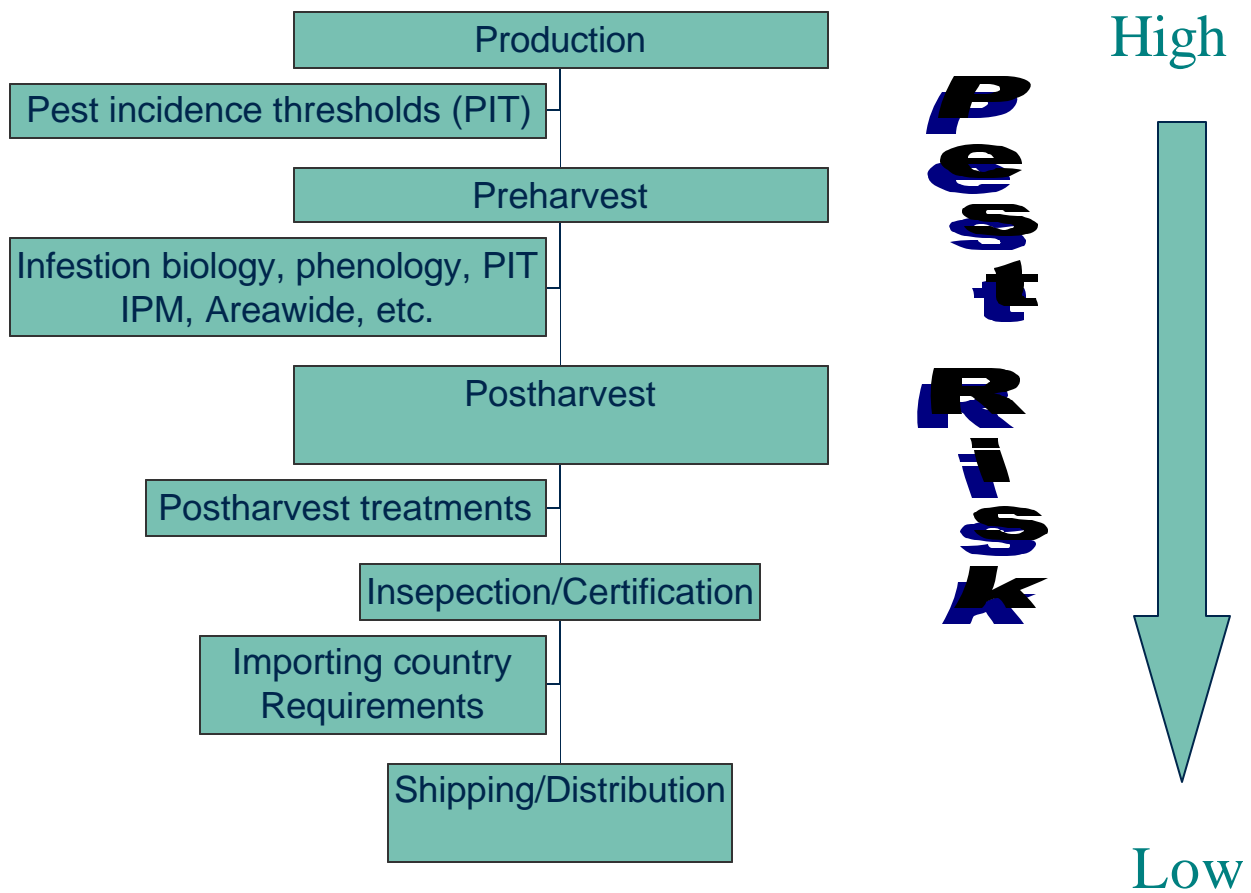


Figure 1. Components of agricultural export “systems approach” using multiple mitigation measures