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Insuring against phytosanitary risks in Dutch protected horticulture: A stochastic model to support policy makers

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ABSTRACT

Dutch protected horticulture is exposed to notifiable phytosanitary pests which are listed in the Quarantine list of the European Union (European Union, 2000). It is uncertain when or which quarantine pest will occur and what financial consequences this will have. These financial consequences stem from measures to be undertaken by growers, as legally required by the European Union (EU, 2000).

A method is presented to derive the probability distribution of phytosanitary costs, which can be used by government and industry to assess risk premiums and to determine the financial consequences of some subsidy on insurance premiums to create an adequate insurance fund. Volume streams and transmission of pests have been simulated for each subsequent product chain stage. Monte Carlo simulation is used to account for uncertainties in the probability of introduction, transmission and detection of a phytosanitary pest. The probability of phytosanitary costs was calculated for a number of selected crops in Dutch protected horticulture. These crop results has been enlarged for all the crops in protected horticulture.

1. Introduction

Phytosanitary guidelines of the European Union (EU, 2000) require a zero tolerance policy for Quarantine organisms (Q-organisms). Individual member states are responsible for taking certain measures when such an organism is notified (i.e., reported detections of Q-organisms). In the worst case, the finding of a Q-organism leads to the destruction of all planting material on a farm, in other cases it requires partial destruction or application of crop protection measures. An indicator of phytosanitary pressure on Dutch protected horticulture is the number of notifications of Q-organisms (Ministerie van Landbouw, Natuur en Voedselkwaliteit, 2006–2012), although notifications might partly concern not regulated organisms and the total phytosanitary inspection effort might have differed over the years. The increasing pressure of Q-organisms leads to increasing phytosanitary costs for government and industry. The Dutch strategic plant health agenda pursues a framework based on a cost and responsibility sharing scheme for phytosanitary risks. The government's main objective is to achieve a more prevention-driven and incentive-oriented approach to financial aid for the control and eradication of plant diseases. From this background the Dutch Ministry of Economic Affairs, the Organisations of Growers (LTO-Glaskracht), Plant multiplication industry (Plantum), Vegetable, Organisation of Fruit Trade (Groente en Fruithuis), United Flower Auctions (VBN) and Organisation of Flower Trade (VGB) signed a ‘Declaration of intention of a Plant health fund’. The calculation of phytosanitary costs under uncertainty, based on expert judgments and experience, is guided and accepted by the Steering Committee of the project with representatives of government and industry as most suitable regarding the objective of the project. The results of this study were discussed and received as reliable and it was accepted that there is uncertainty.

In general, insurance is a strategy in which agents transfer risks that are characterised as low-frequency events but with high adverse impacts. The advantage for the protected horticultural sector of reimbursing affected growers, might be that notifications of a Q-organism take place in an earlier stage, reducing the overall risk (Heikkilä and Niemi, 2009). Insurance in the international agricultural business is a well-known strategy to cope with risks, but phytosanitairy insurance covers are underdeveloped (Waage et al., 2007). According to Meuwissen et al. (2001), the policy holders typically pay a premium to the insurer and receive an

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indemnity payment from the insurer as an insured loss is incurred. Since freedom from diseases is important to the EU, to ensure a free trade amongst member states, governments are allowed to co-finance part of the costs (EU, 2000). Well-known examples in agriculture are crop insurance (e.g. covering weather perils) and livestock insurance (e.g. covering epidemic diseases)'. Premiums for both insurance schemes are normally based on a long history of claims (Meuwissen et al., 2001). Typical examples are the potato insurances in the UK, Denmark and the Netherlands, which cover specific phytosanitary risks (Waage et al., 2007). In the Netherlands, premiums for the potato insurance are differentiated between seed potato, ware and starch potatoes and cover perils including brown rot (Ralstonia Solanacearum), ring rot (Clavibacter michiganensis subsp. sepedonicus) and Potato Spindle Tuber Viroid (PSTVd). The Dutch Potatopol insurance started with a government subsidy (Bullens et al., 2002). After that this insurance has become self-supporting. Another illustrative example is found in Australia, where the costs of prevention, detection and destruction are shared between industry and government (DLA Piper Australia, 2016). Cited from the website of 'Planthealthaustralia' it is described as: 'Government and Industry Parties share the costs of the approved Response Plan based on the EPPs potential impacts on public health, environment or amenity values, regional and national economies, trade and market access, and control or production costs'. Based on these potential impacts, the Categorisation Group can assign EPPs to one of four Categories, which determine the funding ratio.' A number of states finance the direct losses entirely from the national budget (i.e., public system) (Waage et al., 2007), while other states have statutory levies to establish an emergency fund. An overview of different forms of insurance in agriculture in relation to marine fisheries is given in Mumford et al. (2008).

This paper presents a method for calculating the probability distribution of costs of insurance for Dutch protected horticulture to cover future phytosanitary damage due to detection of quarantine organisms (Q-organisms) and one not regulated organism, the Pepper Weevil (Anthonomus eugenii Cano) at the time the calculations were executed. The Dutch government and horticultural industry will use the results as a guideline in assessing risk premiums and to determine the financial consequences of subsidies. The presented model and outcomes only cover the chain stages of 'Multiplication' and 'Production', as agreed upon by the government and industry. The layout of the future phytosanitary insurance scheme for Dutch protected horticulture has not been determined yet. This can be a form of insurance or a fund structure. The lay out of the future phytosanitary insurance scheme for Dutch protected horticulture has not been determined until yet. This can be a form of insurance or a fund structure. The phytosanitary costs are independent to the form of insurance.

2. Method

2.1. Choices of case crops

From a phytosanitary perspective Dutch protected horticulture is characterised by a large number of different host crops for Q-organisms. Dutch horticulture comprises the subsectors of vegetables, cut flowers and ornamentals production. For each subsector, three or four case crops have been selected for a detailed risk assessment (Table 1). The choice of case crops was based on representativeness, economic value, growing period and taxonomic relationship. Per crop a selection has been made of relevant Q-organisms for which a crop is host plant. Potential Q-organisms are listed in the phytosanitary Directive (2000/029/EC) and were completed with expert knowledge of the Dutch Food and Consumer Product Safety Authority (NVWA).

2.2. Chain approach

A chain approach is applied because transmission of Q-organisms in most cases will follow the path of product streams in product chains. For modelling and simulating the product streams the original Chain Risk Model (CRM) is used (Benninga et al., 2012). The CRM model is adapted with a module to calculate the probability of transmission and phytosanitary costs. The model is built in Excel, using Visual Basic. In CRM, each chain stage has the same structure with an incoming and an outgoing product volume stream per crop at a country level with representative processes which take place, such as growing, multiplication, transport and selling. Events that influence the risk, for example the likelihood of infection with a Q-organism, are included in the model. The spread of Q-organisms and inspection activities to detect any Q-organism were also simulated. Most product chains in protected horticulture contain five stages (Fig. 1). Volume streams per crop move from one stage to another. Multiplication of the product in a chain stage increases the volume stream as well as the imported volume. Because organisms are connected to objects and not to weight, the unit is expressed in numbers of objects.

Q-organisms can enter a product chain in different ways and at different chain stages. This is simulated in CRM by distinguishing entry by imports and entry from outside. Q-organisms can spread within a chain stage, which is simulated by multiplication of the organism itself (e.g. insects), multiplication of the product containing the pest (e.g. virus) or both. Both possibilities of multiplication were estimated by expert elicitation. Uncertainty in the model reflects the chance of entry of a Q-organism in the chain, the spread of a Q-organism and the damage after a detection of a Q-organism. Uncertainty is brought into CRM as Triangular distributions.

Infections of Q-organisms are simulated in CRM by the chance of infection per chain stage. In fact all kinds of pathways are summarised by the experts as a chance of infection into one figure. This approach is similar to the one followed in the first comparable animal health calculations (Horst et al., 1999; Jalvingh et al., 1999). Detection can take place at an early stage of the infection, but also when multiplication of an organism has already taken place (i.e., spread) in a following chain stage. A Q-organism might leave the product chain without being noticed. In the inspection module linked to the chain stages, the likelihood of detection depends on the sample size, clustering of Q-organisms and test accuracy (Benninga et al., 2012).

Table 1
Case Chosen case crops per subsector and the percentage of the area of the case crops per subsector.

Vegetables	Cut-flowers	Ornamentals
79,8% area	41,0% area	14,6% area (estimated)
Tomato	Rose	Phalaenopsis
Sweet Pepper	Chrysanthemum	Poinsettia (Euphorbia pulcherima)
Cucumber	Flamengo flower (Anthurium andreanum)	Petunia
Strawberry (only in greenhouses and not field production)		