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New approach to Integrated Pest Management research with and for horticulture. A vision from and beyond economics

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ABSTRACT

The main problem addressed in this paper is the low adoption rate of Integrated Pest Management (IPM) knowledge into practice. Many IPM research leaders believe this low adoption rate is due to bottlenecks in knowledge supply. Consequently, they have asked for research, education and extension efforts that will lead to more widespread use of flexible, locally adapted and practical IPM. In our opinion, however, the bottleneck is a lack of attention for the motivations and framework conditions of the end-users. Therefore, in this paper we shift the focus from technology push to market pull. This paper is based on interviews with Dutch greenhouse growers about the adoption of a new cultivation concept and on export data of tomatoes and apples from Eurostat's Comext database. The two data sources were combined to get understanding of the interactions between entrepreneur types, economic drivers and adoption of new IPM methods. The motivations of the greenhouse growers were captured in mind maps. The export data were analysed for differences between market segments. The main motivations of the growers for adopting innovations such as IPM were getting access to high market segments and achieving better crop growth and lower crop losses. Thus, the challenge for IPM research is integrating tasteful cultivars and product types, advanced agronomy, adequate crop management, attractive packaging and low pesticide residue levels in an inclusive product concept (e.g. residue-free snack tomatoes in a transparent plastic cup). This can be achieved by capturing innovative production strategies from market-oriented entrepreneurs, further developing these strategies in *in-situ* experiments with input suppliers, crop-oriented entrepreneurs and advisers, and co-creating guidelines for integrated production strategies with these partners for both crop-oriented and costs-oriented entrepreneurs. The costs-oriented interviewees often had financial problems and/or plans to sell their business. Consequently, knowledge investments in this specific subgroup will, in many cases, not lead to adoption of new crop protection solutions.

1. Introduction

The adoption of new knowledge and technologies into practice was and is a challenge in agricultural research and innovation. Moore (1991) has described the challenge as 'crossing the chasm'. He observed crucial differences in expectations and needs between early adopters and the early majority. The European Commission (CORDIS, 2014) framed the challenge as 'closing the research and innovation divide'. They observed that despite the continued generation of knowledge through scientific projects, research results are often insufficiently exploited and taken up into practice. In addition, innovative ideas from practice are not captured and spread.

The Standing Committee on Agricultural Research (SCAR, 2016) pointed out that 'new knowledge is generated by farmers, researchers (basic and applied) and private companies'. They concluded that 'the old "linear" model of technology transfer (from scientists to the users) is therefore outdated and should be replaced by an interactive model of networking systems which integrates knowledge production, adaptation, advice and education'. SCAR concluded that scientists in the 'linear' model consider knowledge production as their core-business rather than networking with different stakeholders. Furthermore, they observed that in the 'linear' model innovation and the concomitant entrepreneurial experimentation and management of risk and uncertainty is left to the market. The findings of SCAR explain why the desired two-way traffic between research and practice keeps off.

The background for this paper lies in the disappointment among stakeholders about low adoption rates of innovative IPM methods in practice. Policy-makers become disappointed because of limited impact of their investments in research. The second SCAR foresight

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study (SCAR, 2009) described this disappointment diplomatically by stressing 'the need for renewed political attention to the effectiveness, relevance and scale of Europe's AKIS (Agricultural Knowledge and Innovation Systems) and for a redefinition of AKIS'. Researchers become disappointed because of limited appreciation for their efforts in practice. The leaders of ENDURE, the EU network of excellence for IPM, observed a 'lack of knowledge transfer into practice' and concluded that 'despite considerable interest of more than 150 advisers, a network (of IPM advisers) has not become a reality' (Lamichhane et al., 2016a). Parsa et al. (2014) observed that 'Integrated Pest Management (IPM) continues to suffer from anemic adoption rates in developing countries'. End-users and advisers become disappointed because new knowledge and technologies do not meet their needs and expectations. Buurma and Smit (2016) found that knowledge suppliers were eager to display their specialist expertise and that, at the same time, early adopters were looking for integrated knowledge to improve crop growth and to reduce crop losses. This example illustrates that the early adopters were waiting for another type of knowledge than the experts supplied them.

The strong focus of technical scientists on research results and technical solutions entails a risk that social factors such as motivation and courage of end-users are classified as irrational or unscientific. With this paper, we aim to integrate technical sciences and social sciences in order to bridge the research and innovation divide. This is in line with the conclusion of Barzman et al. (2015) that 'the successful implementation of IPM depends on non-technical aspects such as economics, the social environment of farmers, farm advisory services, and collective multi-actor approaches'. In this context, the authors focus on 'those research, education and extension efforts that will make the mainstreaming of flexible, locally adapted and practical IPM a more widespread reality'. This formulation reveals that Barzman et al. (2015) aimed at making knowledge supply more flexible, locally adapted and practical. Thus, the motivations and the framework conditions of the end-users were not explicitly considered. The aim of this paper is to cover this omission. Therefore, the questions of this paper are:

i. What motivations do growers have for adopting IPM innovations?
ii. How do growers try to overcome the risks of (early) adoption of IPM innovations?
iii. What opportunities do economists see for valorisation of IPM innovations?
iv. What do these motivations, strategies and opportunities mean for IPM research?

The material for this paper comes from two adjacent studies: (i) a study on the adoption of a new cultivation concept in Dutch greenhouse horticulture, and (ii) an analysis of export prices of tomatoes and apples, from exporting countries in Europe, to two types of markets in Europe. These studies were combined to achieve a complete picture of the interactions between adoption of new methods, entrepreneur types, knowledge partners, value chain partners, product qualities, and product prices. Details on data collection in the two studies are provided in Section 2 and Section 3, respectively.

The objective of this paper is to offer a way of thinking to IPM researchers in horticulture for planning and developing IPM technologies tailored to the needs of growers, and thus to achieve higher adoption rates of these technologies in practice. Our view has much in common with the two central themes in the manual of CYMMIT (1980) on 'Planning technologies appropriate to farmers': 'The first is that effective research on agricultural technology starts and finishes with the farmer. The second is that integration of the perceptions of biological scientists and social scientists is an essential element in such research.'

2. Adoption of the new cultivation concept

The New Cultivation Concept (NCC) includes an innovative climate management concept in Dutch greenhouse horticulture. The concept is largely about dehumidification of the air in the greenhouse. Owing to less ventilation, a more humid greenhouse climate and the associated risk of disease problems, the NCC has a close connection with disease management. The NCC and IPM have in common that they are both disruptive or discontinuous innovations, where adoption implies a break with current practices.

2.1. Interviews, mind maps and meta-analysis

The study on the adoption of NCC included face-to-face interviews with 18 Dutch greenhouse growers, who had followed a training on NCC. Their motivations were summarised in 18 personal mind maps. The format of the mind map is depicted in Fig. 1. The format resulted from empirical research of Buurma (1995) on the behaviour of flower bulb growers with regard to disease management in tulips. The search track and the control track have much in common with transformative capacity and adaptive capacity, respectively, as conceptualised by Olsson et al. (2004).

The mind map first captures the context and the urgencies as perceived by the grower. The urgency is the starting-point for a search track (task to be achieved) and a control track (risk to be managed). The search track has the objective to adjust the enterprise to trends in the context (long term). The control track is meant to protect the enterprise against trends in the context (short term). The interventions in the control track mostly increase the urgency to make progress in the search track, because taking emergency measures finally results in frustration and exhaustion. The mind maps of the growers provide a picture and understanding of their knowledge and technology demands.

In a meta-analysis, the mind maps were ranked on the basis of similarities and dissimilarities. Building on personal experience with correspondence analysis (Benzécri, 1973), the mind maps were ranked from focus on product quality via focus on crop health to focus on climate equipment. The result is shown in Annex 1, specifying the urgencies, search agendas and control agendas of the 18 respondents in 18 lines. The ranking shows simultaneous changes in the three main columns. The urgency column changes from serving customers with a top product via healthy plants and healthy crops to a good production at low costs. Simultaneously, the search agenda column changes from getting a better understanding of the interactions between greenhouse climate and crop growth via improving the greenhouse climate to buying climate equipment. At the same time, the control agenda column changes from achieving market success and plant robustness via taking climatic and hygienic measures for disease management to applying fungicides for disease management. Based on these changes (contrasts) in motivations, three types of entrepreneurs were discerned (separated by dotted lines in Annex 1). The entrepreneur types and their motivations are presented in Table 1.

The three subgroups differ in knowledge intensity. The market-oriented entrepreneurs generate knowledge on how to connect customer demands, crop physiology and plant health solutions. The crop-oriented entrepreneurs focus on the question how to improve greenhouse climate and farm hygiene in order to grow a healthy crop. The costs-oriented entrepreneurs focus on the purchase of climate equipment and the use of pesticides to achieve a good production with lower costs. So, the knowledge focus of the three entrepreneur types varies from relatively wide and complex (value chain) to relatively narrow and simple (equipment).

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