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Perception vs practice: Farmer attitudes towards and uptake of IPM in Scottish spring barley

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ABSTRACT

Integrated Pest Management (IPM) offers a suite of ways by which to reduce the need for pesticide use, thus minimising environmental damage and pathogen resistance build-up in crop production. Farmers and agronomists active in the Scottish spring barley sector were surveyed to determine the extent to which they currently use or are open to implementing three IPM measures – varietal disease resistance, crop rotation, and forecasting disease pressure – in order to control three important fungal diseases. Overall, the survey results demonstrate that farmers and agronomists are open to using the three IPM techniques. However, gaps between actual and perceived recent practice were large: despite over 60% of farmers stating that they sowed varieties highly resistant to Rhynchosporium or Ramularia, less than one third of reportedly sown varieties were highly resistant to these diseases. Similarly, over 80% of farmers indicated that they used crop rotations, yet 66% of farmers also reported sowing consecutive barley often/always. Further research is needed in order to understand why these gaps exist, and how they can be reduced in future in order to increase IPM uptake and optimise pesticide use.

1. Introduction

A key challenge facing the present day agricultural sector is the maintenance of high yields while minimising environmentally damaging practices, in order to balance the short- and long-term needs of global food security. One way of attempting to achieve this balance is through the better management of inputs in conventional agriculture, ensuring that products such as pesticides are used only when needed. Pesticide use is widespread, in the aim of maintaining yields (Cooper and Dobson, 2007), but with a variety of concurrent detrimental effects, such as non-target organism toxicity (Beketov et al., 2013), reduced soil biodiversity and health (Walia et al., 2014), and threats to human health (Weisenburger, 1993). Additionally, overuse of, and over-reliance upon, pesticides can lead to pests and pathogens developing resistance to active ingredients, thereby reducing their efficacy (Birch et al., 2011; Fungicide Resistance Action Committee, 2012). The Scottish Government (2016) recommends the use of Integrated Pest Management (IPM), to combat the development of disease resistance, reduce risks to human health, and provide environmental benefits.

IPM is an ecosystem approach which encompasses a variety of techniques for management of pests and diseases, used in combination, and aiming to decrease pesticide use (FAO, 2016). Pesticide use is not prohibited under IPM; rather, the aim is to reduce the need for pesticides, by minimising the likelihood of an epidemic. IPM was first conceptualised over 50 years ago (Stern et al., 1959), yet little is known about its adoption, the barriers to its uptake, and how it is perceived by farmers. In recent years, several surveys of farmers have been carried out in order to gain understanding of IPM-related attitudes, uptake, and priorities – some of these provide case-studies of specific systems (Ilbery et al., 2012; Sherman and Gent, 2014), while others consider a broader range of systems and questions (ADAS, 2002; Bailey et al., 2009; Lamine, 2011). Despite a growing body of literature, relatively little is known about farmer attitudes towards IPM, still less that is relevant in the context of Scottish spring barley (the principle arable crop in Scotland). Information on this topic could aid in focusing research and policy decisions. A number of key legislation changes have also occurred in recent years, including the EU Sustainable Use Directive, which requires member states to support the uptake of IPM (DEFRA, 2013). In light of these policy changes, considering the issues surrounding uptake and interest is a useful exercise.

As the uptake of and attitudes towards IPM are intertwined with market forces and product availability, surveying stakeholders may provide insight into the complex realities which influence IPM decisions. This survey builds on previous work which analysed risk,

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attitudes towards innovation, and sources of information relating to IPM in the UK (Bailey et al., 2009; ADAS, 2002; Ilbery et al., 2013), with a focus on three key fungal diseases affecting spring barley in Scotland – Mildew (caused by *Blumeria graminis f. sp. hordei*), Rhynchosporium (caused by *Rhynchosporium commune*), and Ramularia (caused by *Ramularia collo-cygni*). These are the three most commonly targeted diseases by Scottish farmers when applying fungicides to spring barley (Scottish Government, 2014). Yield reductions due to mildew have been recorded in the range of 11–17% for susceptible varieties (Lim and Gaunt, 1986; Hysing et al., 2012); reductions of 30–40% due to Rhynchosporium (Shipton et al., 1974, cited in Zhan et al., 2008); and Ramularia losses in the UK have been noted at 7–13% (Oxley et al., 2008), though reductions of up to 70% have been reported due to severe epidemics in South America (Pereyra, 2013 cited in Havis et al., 2015). A case-study approach was taken, analysing farmer and agronomist perceptions of three IPM strategies in relation to key fungal diseases of spring barley, providing a snapshot of current barriers and attitudes.

1.1. Survey aims

The primary goal of this survey was to understand the extent to which farmers would be open to implementing, or had already made use of, three IPM strategies identified as having the potential to reduce the need for fungicide use in the cultivation of Scottish spring barley, namely: planned crop rotation, varietal disease resistance, and forecasting disease pressure. Results from the latter IPM technique are not discussed in detail this paper, as sufficient data to compare actual and perceived uptake of forecasting were not gathered in this survey. The primary target population identified was Scottish spring barley farmers, with a secondary target population of agronomists involved in the production of Scottish spring barley, of which a convenience sample (a non-random sample of individuals who are selected based on ease of sampling) was taken in order to obtain a large number of responses despite limited resources. Surveying both farmers and agronomists also allowed for a direct comparison of their opinions and perceptions, providing insight into persistent patterns between the two groups.

2. Methods

2.1. Designing the survey

The survey was designed to be run at the annual agronomy events co-hosted by Scotland's Rural College (SRUC) and Agriculture and Horticulture Development Board (AHDB): Cereals and Oilseeds, where a series of presentations by experts were given around the theme of risk, resilience, and reward at Carfraemill (Scottish Borders), Perth (Tayside), Inverurie (North East), and Inverness (Highlands) during January 2016. These four sites represent a useful geographical spread for data collection, as they are distributed across the main cereal production areas in Scotland. Different farm structure, as assessed at regional level, is also captured by this sample; for example, the Tayside and Scottish Borders regions have more large holdings (> 200ha) than average, while Highland has fewer than average (Scottish Government, 2015). A total of 288 surveys were given out across the four locations (Carfraemill - 100; Perth - 81; Inverurie - 71; Inverness - 36). The survey comprised six sections, where farmers were asked about a range of issues relating to IPM, as well as demographic details. Farmers were asked how often they sowed varieties which were highly resistant to each disease, and to list the varieties they had sown in the past five years, alongside how often they sowed consecutive barley/cereals. Questions were also included relating to attitudes towards fungicide use, and the perceived impact of fungicide use on spring barley yields. Best-worst scaling questions were included to assess which IPM techniques farmers would be most/least open to taking up and which were most/least practical overall and in terms of cost.

To obtain the most relevant information possible, participants were instructed to respond about their majority practices in the survey, recognising that there may be variation at field level within the farm. All farmers at the events who grew spring barley in some capacity were invited to participate, as were agronomists who were involved in decision making for spring barley. The appropriate ethical guidelines were followed for the University of Edinburgh, SRUC, and Scottish Government. The questionnaire went through a number of iterations with feedback given first by a pre-pilot group of seven PhD students, then by a pilot group of four farmers and five agronomists. Pilot participants were asked to give general feedback about the wording of questions and their answers, as well as specific feedback for key questions highlighted in the pre-pilot study and follow-on discussions.

2.2. Analysis

Final results from the questionnaire were first analysed for sampling bias. Consistency across sites was verified for demographic questions (e.g. age and education), as well as one question chosen at random from each survey section. A summary of the sample population was then developed, and compared with the target population statistics available from the Scottish Government. Finally, to verify a lack of attendance bias between sites, several key questions were summarised based on location of survey completion and compared. For questions relating to varietal resistance, comparisons were made using the SRUC/SAC Cereal Recommended Lists for the relevant year (2011; 2012; 2013; 2014). Due to the small sample size and the use of a non-random sampling method, statistical analysis of survey results is presented only where the sample size is thirty or above.

The likelihood of obtaining varietal disease resistance at the levels reported by farmers and agronomists by random chance was also assessed. The average disease resistance rating for each disease was calculated based on the malting varieties reported as having been sown by farmers, and, separately, agronomists. Simulated disease resistance values were then created, by randomly selecting malting varieties for 2011–2014, creating a sample equal to the number of farmers/agronomists who answered these questions in the survey. A mean value of these simulated results was then taken for each disease resistance. This process was repeated 100 times, to create a simulated distribution of the disease resistance ratings which would be expected by random chance. This was then compared against the actual disease resistance ratings reported by farmers and agronomists, to determine the probability of obtaining resistance ratings at least as high as what was reported by stakeholders by chance. This process was then repeated, using only varieties with a disease resistance rating of seven or more (or, in cases where no malting varieties had a rating of seven or more for a given disease/year combination, the highest possible rating was chosen instead), to determine the probability of obtaining varietal disease resistance ratings as low as what was reported by stakeholders, if they were selecting varieties from the most highly resistant choices available in each year.

Chi-square tests were then used to compare results from agronomists and farmers, to determine whether there were significant differences between their reported sowing of consecutive barley/cereals, and beliefs in relation to fungicide use (e.g. “I think finding methods to reduce fungicide use is important”) and fungicide impact on yield.

3. Results

3.1. Survey demographic

A total of 43 farmers and 36 agronomists responded to the survey, giving an overall response rate of 27% (Carfraemill - 15%; Perth - 31%; Inverurie - 30%; Inverness - 44%). Farmers surveyed presented a young, highly educated population with slightly larger farms than average (Scottish Government, 2015). The spring barley producing regions of