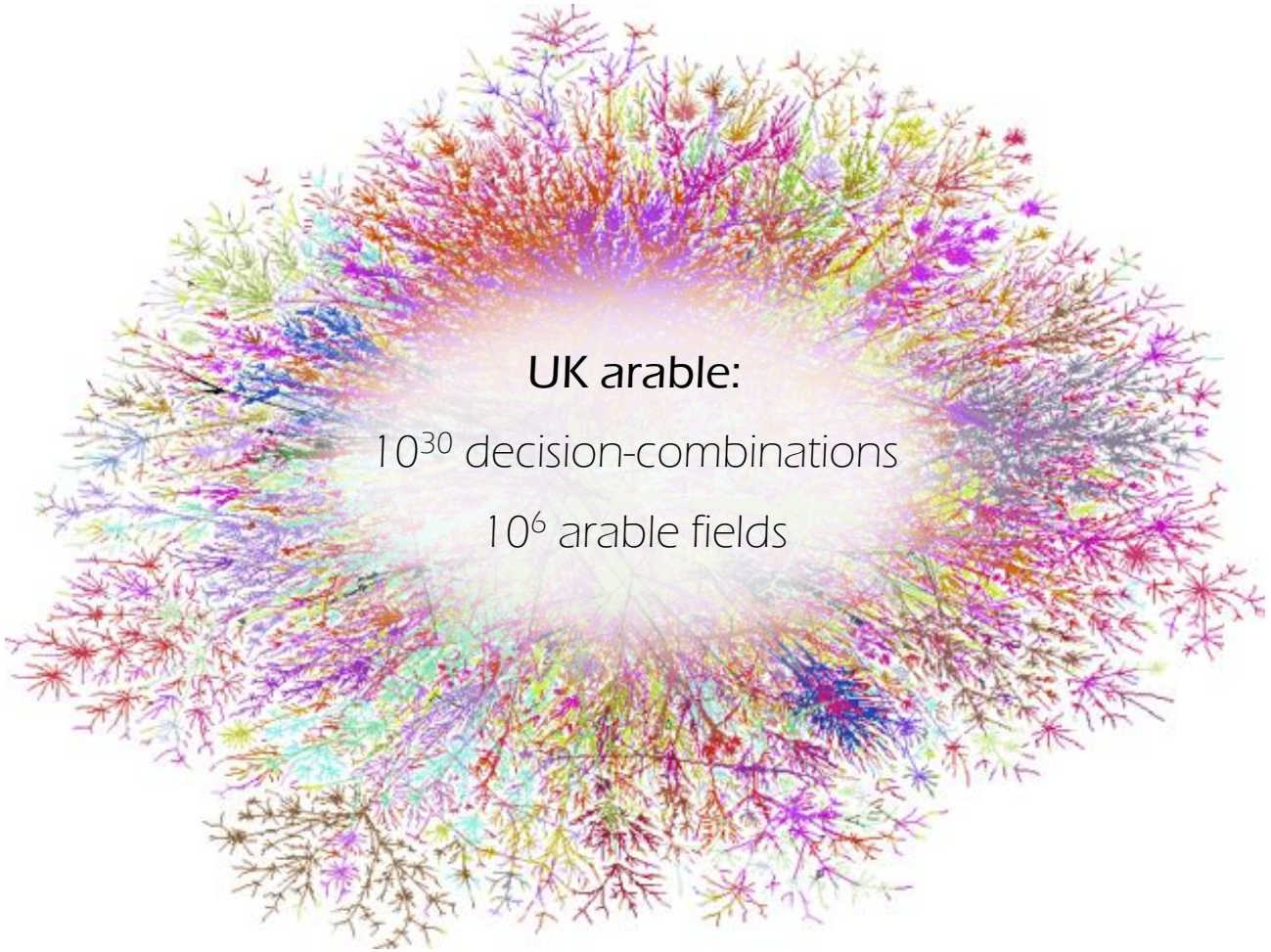
Farmers are faced with lots of data & many decisions: How do they make sense of it all?



Maximising the value of data: through on-farm experimentation

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Successful approaches for on-farm experimentation

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ABSTRACT

On-farm experiments are used increasingly in agronomic research because they are commercially relevant, but they can carry greater risks of failure than traditional small plot experiments conducted by scientists. Experimental failures can result from farmer withdrawal, errors in treatment application or harvest, or non-provision of yield data by farmers. This paper describes the development and testing of approaches for on-farm experimentation and concludes which approaches should be adopted to maximise success. The programme of work included the largest on-farm research network in the UK, with farmers conducting around 50 on-farm experiments per year from 2017 to 2019 to compare fungicide programmes in winter wheat. The project developed management approaches to mitigate the risks of experimental failure such that in 2019, 96 % of experiments were completed and returned a yield result; a greater success rate than is commonly achieved in on-farm experiments. Statistical analysis of yield maps resulted in an average site SED (standard error of the difference between means) of 0.26 t/ha, which is comparable to that achieved in randomised, replicated small plot experiments. The large number of experimental sites enabled a greater level of precision in the cross-site analysis (SED 0.06 t/ha), showing the potential of on-farm experiments for detection of small yield effects if the appropriate yield analysis is undertaken. The project results received substantial publicity within the UK arable farming community, demonstrating the value of effective on-farm research for engaging and informing farmers.

1. Introduction

On-farm experiments (OFE) are experiments conducted on commercial farms, at a relevant scale, and in collaboration with farmers. OFE are widely valued by progressive farmers to compare inputs and approaches, and so to inform future decisions (Kyveryga, 2018; Lacoste et al., 2022). The results can be striking, with 'to-a-line' differences in crop growth providing compelling evidence of treatment effects (Fig. 1). Advantages of OFE over conventional small plot experiments include the greater relevance of tests using commercial farm equipment, and the ability to test spatially variable problems such as spatially variable diseases and pests, or treatments that are best applied with farm-scale equipment such as cultivations and manure. By contrast, the small plot approach is more suitable for treatments which are under development and therefore not licensed for commercial use, experiments involving large numbers of treatments, experiments requiring intensive assessments, or for which limited treatment supplies are available.

OFE can be differentiated into 'farmer-driven OFE' and 'scientist-driven OFE' according to who initiates the research question (Cook et al., 2018), with each approach having different strengths and weaknesses. Unfortunately, farmer-led experiments can be poorly designed, results can be hard to quantify, and even the more striking conclusions are rarely recorded for the long-term or shared effectively with the wider industry (Lawrence et al., 2007). This is a major missed opportunity, since the exceptionally high yields achieved by leading farmers (Sylvester-Bradley and Kindred, 2014; Clarke et al., 2017) and the rise of farmer-led 'field labs' (MacMillan and Benton, 2014), show that much of the progress in agriculture originates on farm. The industry can benefit if new ideas flow 'bottom-up' from farms through applied researchers to academia, to complement the more traditional 'top-down' approach to research.

Consequently, OFE may be most valuable as a partnership between farmers and researchers; to this end, Lawrence et al. (2007) proposed collaboration between researchers and farmers involving planning workshops for farmers before they commence experiments, Schillinger (2010) emphasised the importance of engaging farmers in the aims and design of experiments to give them a sense of ownership of the project, and Lacoste et al. (2022) defined OFE as 'a deliberate process of joint

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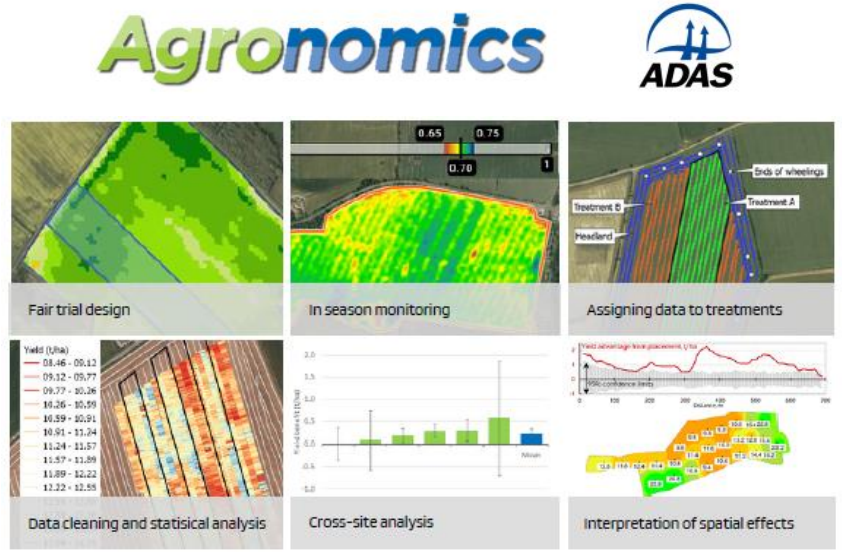

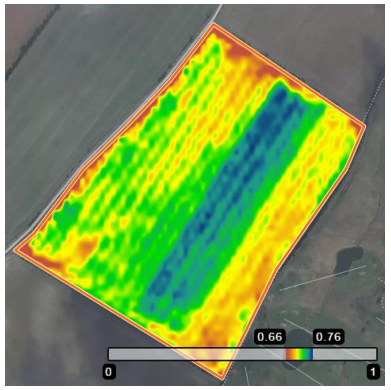

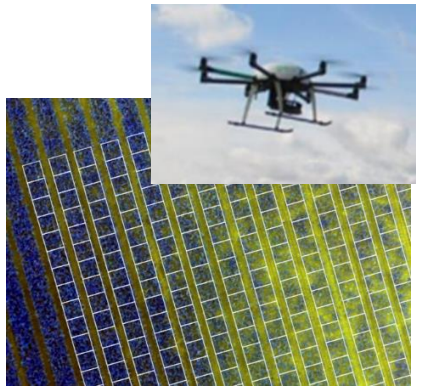

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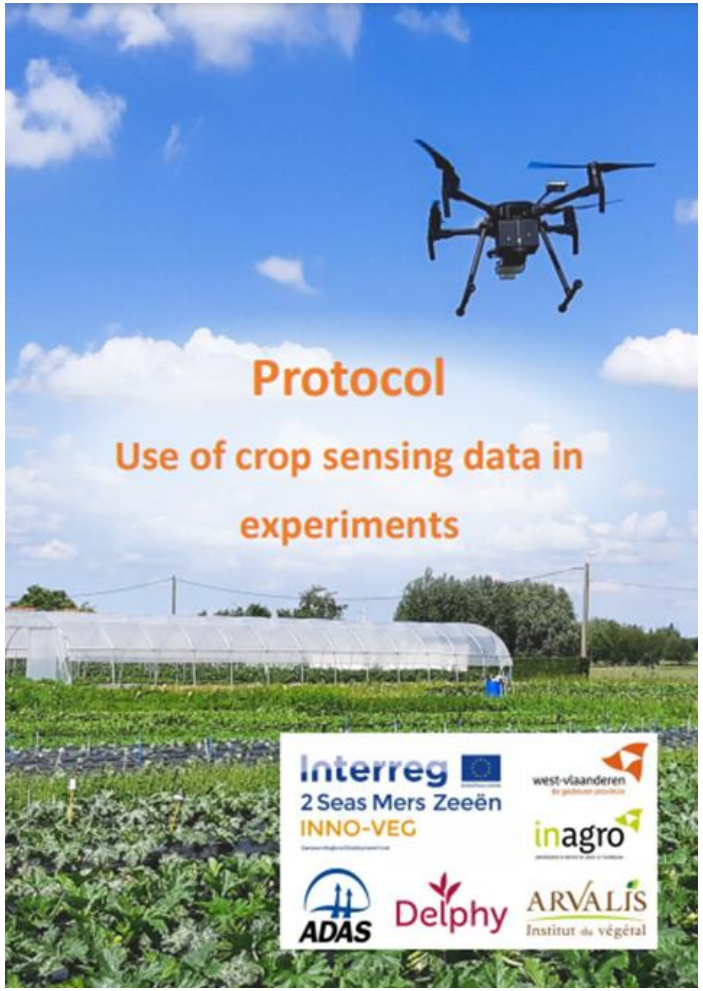
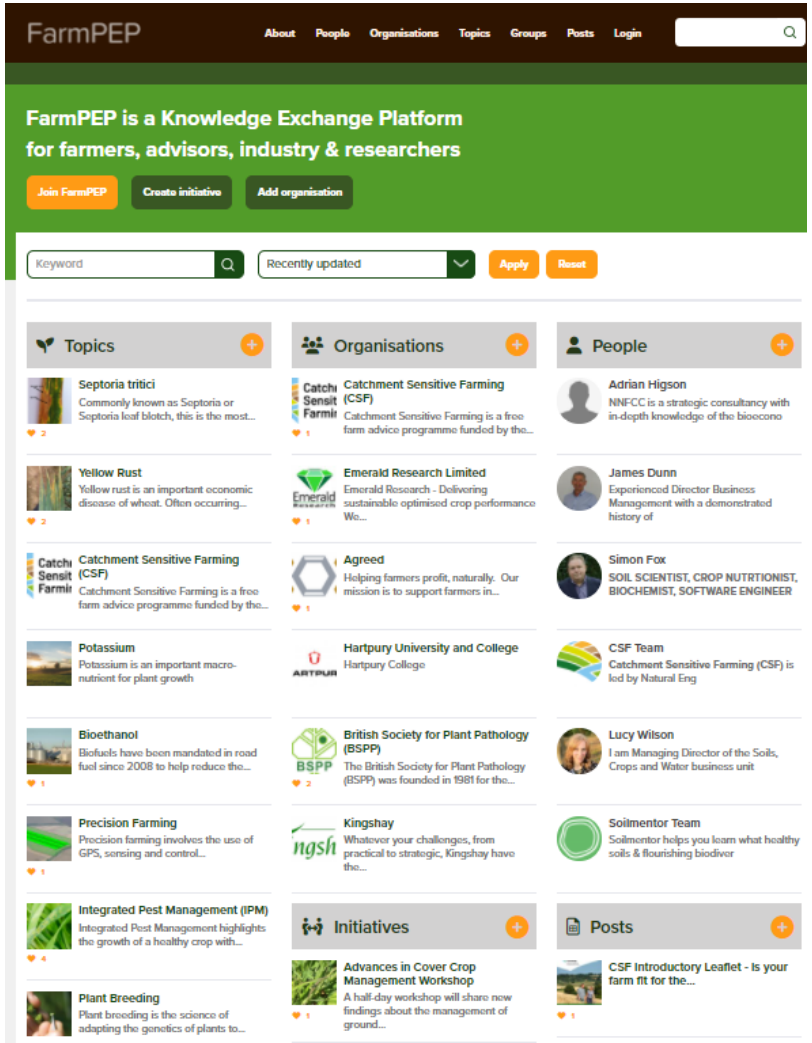


Connectivity is key: data, knowledge, tools

YEN



IPM DECISIONS

Stepping-up integrated pest management decisions support for crop protection