BACKGROUND

The single largest problem in agriculture today is that we lack a method of accurately, efficiently and swiftly evaluating plant health. Take for example our inability to effectively detect plant pathogens, which has two wide-ranging consequences: yield loss and pesticide overuse. Fisher et al. (2012; *Nature*) estimated that fungal infections destroy at least 125 million tons of the top five food crops (rice, wheat, maize, potatoes and soybeans) worldwide. This is enough to feed the entire population of the EU and Mexico for a year. In rice, wheat and maize alone the global cost of fungal diseases was €50 billion in 2012. In terms of environmental impact of fungi, Fisher et al. also suggest that fungi infections are behind 70% of disease-related animal or plant extinctions.

In order to avoid disease related yield loss agricultural producers use expensive and environmentally harmful pesticides. Numerous studies have linked the use of these chemicals to a myriad of social and environmental problems, ranging from decreased long term soil fertility (Fox et al. 2007), rapid decrease of bee populations (Pettis et al. 2013), cancer (Bassil et al. 2007), to increased risk of depression and suicide in farmers (Kamel et al. 2014). Pesticide use is also increasingly spiraling in a vicious cycle: increased pesticide resistance of harmful agents causes agricultural producers to use ever-stronger chemicals. In the EU alone, losses related to pesticide use have been estimated to be at least €10 billion.

As a consequence to not being able to detect plant pathogens swiftly and economically, oversparying is prevalent as an important method of preventing crop diseases. Ideally, the decision of when to spray should be dependent on the highly complex interaction of a wide range of environmental and phenological factors. Essentially, a fungus infection requires the presence of the appropriate weather conditions and the fungus spore. The problem is further strengthened by farmlands' size and microclimate variability which could vary even within a smaller area of a few hectares. As a result, minor differences in humidity or temperature may modify the appearance and the intensity of diseases.

Due to a lack of time, information and appropriate solutions, most farmers are unable to monitor these farmland microclimates when planning their plant protection strategy and consequently are exposed to yield loss and overspraying. With regards to the fungus spore, very few farmers actively monitor their presence. This is primarily because fungi infections occur within the first 1-4 hours of the spore landing on the plant. Thus the time delay between the sample collection and the results of laboratory analyses makes the results unactionable.