

by Victoria Burton & Dr Naomi van der Velden

Two hundred years ago nearly all scientists were passionate volunteers who made their living in some other profession. The radical discoveries of Charles Darwin were made as an unpaid assistant on the Beagle and through his own experiments in the grounds of his house in Downe, Kent. The rise of science as a paid profession is relatively recent, and volunteers still play a large role in scientific fields where skill in observation is more important than expensive equipment. For

example, volunteers give 7,500,000 hours a year towards recording the state of nature in the UK, many new galaxies and comets have been discovered by amateur astronomers, and 60% of new animal descriptions in Europe between 1998 and 2007 were made by amateur naturalists.

Today, involvement of volunteers in collection and/or processing of scientific data, or citizen science as it is now known, is booming. Most citizen

science projects are led by institutions and designed to answer questions posed by scientists. Such projects are dominated by monitoring nature. Relatively few agricultural and horticultural institutions are developing citizen science projects, although many do work with farmers who volunteer their land and/or time. Perhaps this is because university research questions tend to be focused on large-scale, mechanised growing.

Citizen science is

sometimes referred to as democratisation of science, enabling wider participation. However, if researchers truly wish to democratise science they need to support participants to decide their own research questions, design experiments, collect, analyse and share their findings.

There are already a few examples of this happening; BBC Radio 4's Material World So you want to be

a scientist? asked listeners to submit their scientific questions. The winners were supported to design an experiment to test their question. In their 2010 competition, gardening grandmother Ruth Brooks designed an experiment to test if garden snails return to a home location and encouraged gardeners all over the UK to mark and swap snails with their neighbours. Ruth even wrote a book on her experience - *A Slow Passion: Snails, My Garden and Me*.

Humans are naturally curious and experimentation is how

we learn. Children pose questions about the world, make a change, and see what happens. At some point most people shift to the mindset that science is something done by 'experts' in institutions. Despite that outlook, it cannot be denied that all growers experiment - techniques or crops are tried, results assessed, reviewed and perhaps even shared. Their findings change how they grow in future, either dropping something which didn't work out well, or continuing with those things that are successful. However, growers don't always recognise the science in their approaches, and self-confidence in scientific abilities can be low. Tools for exploring and analysing

The Evolution of Citizen Science

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data can also be difficult to access and use. Imagine what we could discover if small-scale growers came together to share knowledge, investigate practices, and go beyond citizen science to become citizen researchers!

The Permaculture Association has already run experiments in permaculture practices that anyone could take part in. In 2011, the mixed vegetable polyculture trial was run in partnership with the University of Cumbria - it involved fifty people comparing a plot with three crop species with one of twelve crop species. The aim was to investigate growing food plants in communities, polycultures, to understand what could be more productive and how much effort was needed. Very few studies have looked at mixes of more than three crop species. In terms of the total food produced per area

the high diversity plot was slightly more productive, however, because there was a lot of variation between growers this difference was not statistically significant. So, growing twelve crops together didn't produce more food per square metre than growing three. What this trial did find, however, was that productivity can be high. Average yields equated to 35 tonnes per hectare, with one grower achieving over 100 tonnes per hectare. It was clear that polycultures have potential but more research would be needed to find good crop mixes.

Another trial in 2014 tested whether or not it is possible to grow soya on a small scale in Britain. Eighteen Permaculture Association members planted soya bean seeds on 22 sites across the UK. Results were conclusive - only one site produced some beans, even then the yield was half that

expected. Despite finding that soya cannot be reliably grown outside in the UK, half of the participants who signed up for the trial returned results, which is a much higher rate than many citizen science projects.

More recently, the Permaculture Association is using citizen research as part of the GROW Observatory, a European Union Horizon 2020 funded research and innovation programme. In 2018 the Permaculture Association, James Hutton Institute, and IIASA worked with the University of Dundee to create and run a free massive open online course (MOOC) to help growers, gardeners and others better understand the challenges of food production, regenerative growing practices and how to investigate the impacts or benefits of these in their own growing. Originally, the intention was to help communicate

well-researched practices that regenerate soils and benefit biodiversity, whilst growing food. However, we discovered that almost all the scientific research and experiments on topics such as using cover crops, mulching and planting legumes, was at the scale of mechanised farms. Virtually none was at the scale of growing that most GROW participants are interested in - home gardens, allotments and market gardens.

The Great GROW Experiment was one of the activities run by the GROW Observatory, designed to compare three crops grown in a polyculture with those same three crops grown separately in monocultures. This was an innovative experimental rather than observational study. There was a focus on training participants to be citizen researchers through the online course

in how to do research in their growing space, implement the experiment and interpret their own results. Experimenters were supported from May 2018 to October 2018 with regular emails, a dedicated online forum, and monthly live meetings where they could learn from the scientists running the experiment and share insights with each other. In November, another free course showed how to understand the results and shared the initial collective findings. There was a high level of deep engagement in the experiment, with participants meeting up in real life, inspiring their friends, and even being interviewed on local radio.

"I would definitely participate in citizen experiments again if they are as well guided as this one. It has been a great learning experience, I also find it empowering and meaningful to do this not only for myself but for a wider community and for science."

Many said that, as a result of participating they were inspired to improve their observations and record-keeping, and were setting up experiments of their own from testing out new soil improvement methods to growing new crops in new ways.

Overall, the polyculture planting was significantly more successful, with the beans doing particularly well. However, this wasn't the result for everyone - about 30% of experimenters had better yields from the monoculture plantings. There is clearly more to learn and a growing appetite to take the learning out of the classrooms and into the garden.

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participate:
permaculture.org.uk/research/three-sisters-polyculture-experiment-2019

learn:
permaculture.org.uk/research/research-handbook-and-training