

# Food for thought



**The ‘listicle’ has been a staple of internet content since the earliest days of the world wide web. But a recent example in *New Phytologist* has rather more significance than ‘The top 50 therein players of all time’.**

In 2011, Claire Grierson and twelve colleagues published a Letter in *New Phytologist* called ‘One hundred important questions facing plant science research’<sup>1</sup>. It did exactly what the title suggests, putting forward one hundred questions representing significant challenges related to plant biology at that point. Twelve years later there are two more papers in *New Phytologist*, looking back on the previous piece<sup>2</sup> and looking forward with a further hundred questions<sup>3</sup>.

The first quandry that any endeavour such as this raises is how to assemble a hundred entries in anything like an objective fashion. In 2011, Grierson et al. invited questions to be submitted through a website that was publicized to “plant scientists in the UK and abroad,” farmers and any other interested parties. The website collected submissions for three months, yielding a long list of 350 questions. This list was then whittled down to 96 by fifteen individuals at a two-day workshop held in Bristol, UK.

For the 2023 version, Armstrong et al. have adapted and broadened the original methodology to create ‘an international perspective’. The candidate questions were again collected by online submission open to anyone. However, the authors made a particular effort to be truly global, with an emphasis on contacting research institutions outside the Global North, and the questions could be submitted in any of eight languages.

The result was a substantially longer list of 616 questions, which was reduced to 208 by removal of those that were out of scope and the combining of duplicated or closely related suggestions. The selection of panelists to choose the final 100 questions was at least as careful as selection of the questions

themselves. Anyone submitting a question was able to express an interest in serving on the final selection panels; of these, 86 prospective candidates were invited to apply, of which 20 were selected who provided a balance of genders and geographical connections. These were split into four regional panels, the selections from which were collated by a final panel of eight, chaired by Emily May Armstrong, lead author on the paper.

The care that has been taken in this modern study to achieve diversity and inclusivity is admirable. It is reassuring to see that the major topics covered are broadly similar to the 2011 endeavour, but the tone seems subtly changed. In both lists, the majority of questions begin with a ‘How’, and yet the 2023 versions seem more urgent and immediate in their focus on direct threats not of the future, but that are already having serious effects right now. For example, on the topic of the adoption of genetically modified organisms, 2011 asked “Considering two plants obtained for the same trait, one by genetic modification and one by traditional plant breeding techniques, are there differences between those two plants that justify special regulation?”, while 2023 demands “How should the scientific community better represent the benefits and risks of GMOs and gene-edited plants to the public?”; on effective fertilizer usage, 2011’s “When and how can we simultaneously deliver increased yields and reduce the environmental impact of agriculture?” has become 2023’s “How can we optimise fertilizer use in a changing climate?”; or concerning epigenetics, 2011 wanted to know “To what extent do epigenetic changes affect heritable characteristics of plants?”, while 2023 asks “How can scientists harness trans-generational transmission of stress-related ‘memory’ in plants?”.

Such comparison could be regarded as unfair. Much has happened over the past decade in plant science and beyond, and this is the topic of Larson et al.’s ‘Reflecting on a decade of plant research’<sup>3</sup>. CRISPR and gene editing were not prominent enough to appear anywhere in the 2011 list. The word ‘pandemic’

makes no appearance in the 2011 selection, while 2023 asks “How can we be better prepared to tackle future plant virus disease pandemics?”, which only seems appropriate given that viral, fungal and other pathogens are estimated to reduce the yields of major crops by 30% or more worldwide<sup>4</sup>, although it was not a plant disease that brought the word into common usage.

As with any ‘top 100’ list, much of the fun is finding surprising entries and glaring omissions – I was personally a little taken aback to see “How do we adapt plants for space travel?” and “Can scientists create sustainable organic closed systems to support human life in challenging environments?” rubbing shoulders with the likes of “How do we ensure enough funding is available to preserve biodiversity in socioeconomically disadvantaged regions?” – but what comes through most clearly from surveying the list is the focus on solving practical problems. The 2023 list is shot through with concerns over climate change, food security, sustainability and protection against disease (both plant and human); only rarely are more ‘fundamental’ scientific questions raised, such as “What controls plant genome size and complexity?” or “What is the plasticity of the epigenome of plants?”. It also feels significant that the 2023 selection has three detailed and specific questions relating to plants in cities, whereas in 2011 there was only a quite generic “How can we use plants and plant science to improve the urban environment?”.

Any list such as this can be disagreed with and have its details argued over. Their ability to spark debate may be their greatest value. Nonetheless, we hope that all the work published in this and every issue of *Nature Plants* goes some way towards answering at least one entry.

Published online: 22 May 2023

## References

- Grierson, C. S. et al. *New Phytol.* **192**, 6–12 (2011).
- Larson, E. R. et al. *New Phytol.* **238**, 464–469 (2023).
- Armstrong, E. M. et al. *New Phytol.* **238**, 470–481 (2023).
- Ristaino, J. B. et al. *Proc. Natl Acad. Sci.* **118**, e2022239118 (2021).