Dandelion Rubber

"We're trying to speed up the crop domestication process that took thousands of years for most of our crops...We think we can do it in 20 years"

— John Cardina, Ohio State University, 2021[10]

The Problem

Global natural rubber supply relies on a single tree - Pará rubber tree (*Hevea brasiliensis*) – grown primarily in Southeast Asia[1], creating both economic and environmental risks from, for example, disease, deforestation and supply disruption. This has driven interest in alternative sources of rubber.

The Promise

Since the 1930s, *Taraxacum kok-saghyz* (TKS, or Russian dandelion), which produces high-quality rubber in its roots, has been proposed as an alternative industrial crop[2].

Since the late 2000s, renewed research efforts have combined conventional breeding with gene editing to increase yield, improve growth and accelerate domestication, with the aim of creating a scalable, locally grown source of natural rubber to reduce reliance on tropical plantations[3].

In February 2026, the UK's John Innes Centre announced that, as part of a £2.4m programme funded by the UK Farming Innovation Programme (FIP), it had been working to source dandelions from partners around the world, building a resource from which it can choose varieties most suited to rubber production.

This resource, it claimed "will enable us to use gene editing and analytical tools to domesticate the plants and optimize them to produce a higher-grade product in greater quantities.[4]"

Development Timeline

- 2008 – Ohio State University launches a $3 million programme to develop TKS as a domestic rubber source[5].
- 2009 – German researchers report enzyme modification increasing latex yield up to 4–5 times[6].
- 2011 - Continental Tyres begins researching dandelion rubber[7].
- 2017 – First comprehensive transcriptome published, identifying genetic markers associated with rubber production[8].
- 2018 – The first draft TKS genome was sequenced and assembled[9].
- 2020 – Researchers at Ohio State University claim domestication of TKS could be achieved "within 20 years"[10].
- 2025 – Academic literature still describes TKS breeding as "in its early stages"[11].
- 2026 – £2.4 million UK funding awarded to develop gene-edited dandelions using indoor aeroponic systems[12].

Scientific and Technical Challenges

Successful commercialisation of TKS depends on increasing rubber yield per plant, but the enzyme system responsible for natural rubber biosynthesis remains incompletely understood[13].

A central limitation is metabolic competition. In TKS roots, carbon is partitioned between rubber and inulin[14]. Increasing rubber without affecting growth and resilience is not straightforward. The plant must balance rubber production with other functions, such as storing inulin – which is inversely correlated with rubber – for energy balance and stress tolerance[15].

As a result, despite some progress in genetics and breeding, reliably boosting rubber yield through genetic engineering remains scientifically complex and, currently, dandelion rubber supplies 0% of the global market.

TKS still has several other inherent challenges, such as the need for constant soil moisture during germination, slow growth rate, low competitiveness with weeds, significant rubber yield only at maturity, high heterozygosity and self-incompatibility[16].

Domestication requires coordinated modification of all these multiple traits simultaneously, most of which are polygenic (controlled by multiple genes). Editing single genes may improve discrete traits, but transforming a wild species into a robust, large-scale industrial crop requires extensive iterative breeding, field validation and trait stacking.

Continental, one of the world's largest tyre manufacturer, opened a dedicated research centre in 2018 and produced prototype tyres, despite ongoing yield constraints[17].

The EU-funded DRIVE4EU project (2014–2018)[18] likewise advanced TKS as a European source of natural rubber using conventional breeding and process optimisation. It developed higher-biomass hybrid lines, expanded trials to multi-hectare scale and demonstrated pilot rubber extraction and prototype tyres. However, it concluded that current yields remain economically uncompetitive, with high cultivation and harvesting costs.

Even where technical progress is made, economic viability remains uncertain. Neil Clelland, Chief Business Officer of QuberTech – which is collaborating with John Innes and the aeroponic company LettUs Grow on the FIP funded programme – notes that the company's aim is to target "entry markets that are higher value, better quality and lower volume".

These include the medical, footwear and fashion sectors. He cites "Out-soles for sneakers, tops for injectables and seals for the little vials that drugs come in, latex gloves, condoms, adhesives for plasters" as key product categories[19].

However, viability still requires sufficient yield per hectare, mechanised harvesting, efficient processing and established supply chains. A major bottleneck remains extraction: current methods rely on solvents or microbiological processes[20] that are not yet scalable or cost-effective, limiting the transition from research to industrial production.

Conventional Breeding Alternatives

Industry interest in alternative rubber sources persists. Guayule (*Parthenium argentatum*) offers a parallel alternative. This desert shrub produces high-quality rubber and has been developed through breeding and agronomic improvement. Companies including Yulex and Bridgestone have demonstrated technical feasibility, although further gains in yield, harvesting and processing are needed[21].

Research into more sustainable synthetic rubber systems is also ongoing, but matching the performance and scalability of conventional rubber remains a challenge.

Beyond the Hype

Despite nearly two decades of modern research, commercial-scale production of dandelion rubber remains distant. Even recent literature describes development as being "in its early stages"[22].

A central constraint is yield. Rubber production depends on complex metabolic processes and competes with inulin storage, creating trade-offs that limit output. At the same time, domestication requires coordinated improvement of multiple interacting traits under real-world conditions.

Economic barriers also persist. Pilot-scale systems remain costly, industrial processing is unresolved and supply chains are undeveloped. While gene editing may accelerate incremental gains, transforming a partially domesticated wild species into a globally competitive industrial crop remains a long-term challenge.

Finally, changing the source of rubber does not address its downstream environmental impacts. As tyres wear, they release micro-particles into air, soil and water, contributing significantly to global microplastic pollution[23].

Estimates suggest tyre wear accounts for around 100,000 metric tons of microplastics entering the oceans each year[24]. At end of life, their complex composition – combining natural and synthetic rubbers with fillers, metals and additives – makes them difficult to recycle[25]. And while you could make tires from 100% natural rubber, it also degrades faster, further increasing demands on rubber supplies.

Shifting production geographically also does not eliminate deforestation pressures. Land-use change is driven by economic returns: where rubber declines, other crops often replace it. In Southeast Asia, as rubber prices have fallen, rubber plantations have already been converted to commodities such as oil palms[26] and exotic fruits[27] as well as bananas, cashews and black pepper, maintaining pressure on forests[28].

For these reasons, dandelion rubber highlights a broader truth: innovation in the lab does not necessarily translate into rapid, scalable or sustainable solutions in the real world.

References

1 Inkonkoy F (2021). Sustainability in the natural rubber supply chain: Getting the basics right. SPOTT. London: Zoological Society of London. https://www.spott.org/wp-content/uploads/sites/3/dlm_uploads/2022/06/SPOTT-Rubber-Report-Singles-Jun-22-update.pdf

2 Kuluev B *et al* (2023). Molecular Genetic Research and Genetic Engineering of Taraxacum kok-saghyz L.E. Rodin, Plants, 12(8): 1621. https://www.mdpi.com/2223-7747/12/8/1621

3 Renewable Carbon News (2008) Dandelion Rubber for Airplane Tires. https://renewable-carbon.eu/news/dandelion-rubber-for-airplane-tires

4 John Innes Centre Pres Release (2026). Sugar beet, oilseed rape, tomatoes and dandelions: four precision breeding projects win major funding to support UK agriculture. https://www.jic.ac.uk/press-release/sugar-beet-oilseed-rape-tomatoes-and-dandelions-four-precision-breeding-projects-win-major-funding-to-support-uk-agriculture

5 Renewable Carbon News (2008), *op cit* 3

6 Phys.org (2009). Dandelion rubber. https://phys.org/news/2009-09-dandelion-rubber.html

7 Continental (2022). Natural Rubber from Dandelions: Taraxagum. https://www.continental-tires.com/about-us/sustainability/activities-and-initiatives/design-and-sourcing/taraxagum

8 Luo Z *et al* (2017). Analysis of the first Taraxacum kok-saghyz transcriptome reveals potential rubber yield related SNPs, Scientific Reports, 9939. https://www.nature.com/articles/s41598-017-09034-2

9 Lin T *et al* (2017). Genome analysis of Taraxacum kok-saghyz Rodin provides new insights into rubber biosynthesis, National Science Review, 5(1): 78-87. https://academic.oup.com/nsr/article/5/1/78/4093910

10 Long J (2020). Ohio State researchers work to solve global rubber shortage, The Lantern, 29 January. https://www.thelantern.com/2020/01/ohio-state-researchers-work-to-solve-global-rubber-shortage

11 Kaiser R *et al* (2025). Population structure and genetic diversity of rubber-producing dandelion (Taraxacum kok-saghyz) and other Taraxacum species, Industrial Crops and Products, 229:121035 https://www.sciencedirect.com/science/article/pii/S0926669025005813

12 HortiDaily (2025), £2.4M project to domesticate dandelions for UK glasshouse-grown rubber, 24 March. https://www.hortidaily.com/article/9807885/ps2-4m-project-to-domesticate-dandelions-for-uk-glasshouse-grown-rubber

13 Tan Y (2023). Advances in Genome Sequencing and Natural Rubber Biosynthesis in Rubber-Producing Plants, Current Issues in Molecular Biology, 45(12): 9342-53. https://www.mdpi.com/1467-3045/45/12/585

14 Cherian S *et al* (2019). Natural rubber biosynthesis in plants, the rubber transferase complex, and metabolic engineering progress and prospects, Plant Biotechnology Journal; 17(11):2041-61. https://onlinelibrary.wiley.com/doi/full/10.1111/pbi.13181

15 *Ibid*

16 Kuluev B *et al* (2023), *op cit* 2

17 Continental (2022), *op cit* 7

18 CORDIS (2018). DRIVE4EU: Dandelion Rubber and Inulin Valorization and Exploitation for Europe. https://cordis.europa.eu/project/id/613697/reporting

19 Giddings A (2026). How a genetically-edited dandelion could stop you getting pregnant. Metro, 30 January. https://metro.co.uk/2026/01/30/a-genetically-edited-dandelion-stop-getting-pregnant-26607749

20 Kuluev B *et al* (2023), *op cit* 2

21 Hern Boon Z *et al* (2022). Recent development of biodegradable synthetic rubbers and bio-based rubbers using sustainable materials from biological sources, RSC Advances, 12: 34028-52. https://pubs.rsc.org/en/content/articlehtml/2022/ra/d2ra06602e

22 Kaiser R *et al* (2025), *op cit* 10

23 Kole PJ *et al* (2017). Wear and Tear of Tyres: A Stealthy Source of Microplastics in the Environment, Int J Environ Res Public Health, 14(10):1265. https://www.sciencedirect.com/science/article/pii/S0269749117317132

24 Boucher J and Friot D (2017). Primary microplastics in the oceans IUCN. https://portals.iucn.org/library/node/46622

25 Abbas-Abadi MA *et al* (2022). Towards full recyclability of end-of-life tires: Challenges and opportunities, Journal of Cleaner Production, 374:134036. https://www.sciencedirect.com/science/article/abs/pii/S0959652622036083

26 Jayathilake HM *et al* (2023). The conversion of rubber to oil palm and other landcover types in Southeast Asia, Applied Geography, 150:102838. https://www.sciencedirect.com/science/article/abs/pii/S0143622822002090

27 Navya PK (2025). Farmers swap rubber for exotic fruits, chasing higher profits, Mongabay. https://india.mongabay.com/2025/08/what-a-shift-in-farming-from-rubber-to-exotic-fruit-trees-could-mean-for-kerala

28 Hurni K and Fox J (2018). The expansion of tree-based boom crops in mainland Southeast Asia: 2001 to 2014, Journal of Land Use Science, 13(1-2). https://www.researchgate.net/publication/326497083_The_expansion_of_tree-based_boom_crops_in_mainland_Southeast_Asia_2001_to_2014

Dandelion Rubber

is an addendum to the 2025 report

Turbo Charging Nature?

The fast promises and slow progress of gene edited crops

Research and text Pat Thomas and Ayms Mason

As new examples appear we will periodically update the full report.