OXFORD

Journal of Intellectual Property Law & Practice, 2026, Vol. 00, No. 00

DOI:10.1093/jiplp/jpaf080

Article

Can you patent a plant? What dandelion rubber reveals about IP law in the UK and EU

Robert Hargreaves *

Robert Hargreaves is a Lecturer in Law at York St John University.

*E-mail: r.hargreaves@yorksj.ac.uk

Abstract

- This article examines the patentability of plant-based innovations through the case of dandelion-derived rubber, a sustainable alternative to tropical rubber trees. The Russian dandelion (*Taraxacum kok-saghyz*) offers strategic and environmental benefits, prompting major investment by Continental AG and Goodyear in biotechnological processes to commercialize its latex. These developments raise critical questions about the scope of intellectual property protection in the UK, EU and USA.
- The analysis focuses on Directive 98/44/EC, the European Patent Convention (the Munich Convention) (Munich, 5 October 1973; 1065 UNTS 199) and the UK Patents Act 1977, highlighting the legal distinction between unpatentable natural discoveries and patentable technical interventions. It shows how companies secure rights over extraction methods and industrial compositions rather than the plant itself, while US law permits broader subject matter, including some plant varieties. The article also explores European Patent Office case law (G 2/07, G 1/08 and G 3/19) and the implications of Brexit for UK practice.
- Beyond doctrine, it considers policy debates on biodiversity, biopiracy and benefit-sharing under the Convention on Biological Diversity (the Biodiversity Convention; CBD) (Rio de Janeiro, 5 June 1992; 1760 UNTS 79), Nagoya Protocol and Agreement on Trade-Related Aspects of Intellectual Property Rights. The dandelion rubber example illustrates how IP law can incentivize green innovation while safeguarding the public domain, but it also exposes risks of portfolio-level enclosure that challenge sustainability and equitable access.

I. Introduction

In the face of climate change, deforestation and the mounting environmental toll of globalized supply chains, the search for sustainable alternatives to traditional materials has become more urgent than ever.[1] One of the more innovative responses to this challenge is the industrial revival of the Russian dandelion (*Taraxacum kok-saghyz* [*TK*]), a plant with a remarkable ability to produce high-quality natural rubber in its roots.[2] Although known since the early 20th century, particularly during wartime shortages of rubber,[3] the species has only recently become viable for commercial exploitation, thanks to advances in plant genetics, agronomy, and processing technologies.[4]

In recent years, companies such as Continental and Goodyear have spearheaded efforts to cultivate dandelion rubber at scale, investing in biotechnological research and forging partnerships with agricultural institutes.[5] Their aim is twofold: to reduce dependence on the tropical rubber tree (*Hevea brasiliensis*), whose cultivation contributes to deforestation and biodiversity loss,[6] and to gain a commercial advantage by securing IP rights over novel rubber sources and their applications.[7] Dandelion-derived rubber is already being trialled in tyres, bike products and other industrial uses,[8] suggesting that this once-obscure plant could form the backbone of a new sustainable materials economy.

Yet this innovation raises a fundamental legal question: can you patent a plant or, more precisely, the processes, compositions, and products derived from one? The answer is far from straightforward and varies significantly between jurisdictions. This article examines the legal framework surrounding biotechnological innovation and plant-based IP, with a focus on the approaches adopted in the UK, EU, and the USA. In doing so, it examines the patents filed by Goodyear and Continental, considers the implications of international patent regimes and evaluates how the law balances scientific innovation with public access and ethical concerns.

[1] Intergovernmental Panel on Climate Change (IPCC), *AR6 Synthesis Report: Climate Change 2023* (2023).

[2] Katrina Cornish, 'Alternative Natural Rubber Crops: Why Should We Care? (2017) 18 *Technology & Innovation* 244–55.

[3] Jeroen B van Beilen and Yves Poirier, 'Establishment of New Crops for the Production of Natural Rubber' (2007) 25 *Trends in Biotechnology* 522.

[4] Fraunhofer Institute for Molecular Biology and Applied Ecology (IME), 'Dandelion—a new source for rubber' (Fraunhofer 2024). Available at https://www.ime.fraunhofer.de/en/fields_of_research/plant_biotechnology/dandelion-as-a-source-of-rubber.html (accessed 29 May 2025.

[5] Continental AG, 'Taraxagum Lab Anklam' (webpage, no date). Available at https://www.continental-tires.com/car/about-us/sustainability/vision-2030/taraxagum-lab-anklam/ (accessed 29 May 2025).

[6] Global Witness, 'Rubber Barons: How Vietnamese Companies and International Financiers Are Driving a Land Grabbing Crisis in Cambodia and Laos' (2013). Available at https://www.globalwitness.org/en/campaigns/land-deals/rubberbarons/ (accessed 29 May 2025).

[7] Goodyear Tire & Rubber Company, 'Goodyear Developing Tires with Dandelion Rubber' (Goodyear Newsroom, 2021). Available at: https://corporate.goodyear.com/us/en/media/news/goodyear-developing-tires-from-dandelion-rubber.html (accessed 29 May 2025).

[8] European Patent Office, *EP3275837B1 Rubber Composition and Pneumatic Tyre* (Continental AG, granted 3 February 2021).

II. The scientific and commercial context

The Russian dandelion is a hardy, fast-growing plant that produces high-quality natural latex in its roots. This distinguishes it from most other temperate species and makes it a viable alternative to *H. brasiliensis*, the tropical rubber tree traditionally used in the global rubber industry.[9] The yield of latex from Russian dandelions is lower per plant than from rubber trees, but the short growth cycle (approximately 1 year), tolerance to cold climates and adaptability to mechanized farming offer considerable commercial and environmental advantages.[10]

By contrast, *H. brasiliensis* is largely cultivated in monoculture plantations across Southeast Asia, where it is highly susceptible to disease outbreaks such as South American leaf blight (*Microcyclus ulei*), and is a known driver of deforestation, biodiversity loss and social conflict linked to land acquisition.[11] The ecological risks and volatility associated with rubber tree cultivation have spurred interest in developing alternative sources. Because the Russian dandelion can grow in temperate zones, including much of Europe, North America and parts of Central Asia, it offers a decentralized model of production that enhances supply chain resilience, reduces transport emissions and lowers dependency on vulnerable tropical ecosystems.[12]

The renewed commercial interest in this plant has been made possible by major advances in genetics, agronomy and biochemical processing. Research institutions such as the Fraunhofer Institute in Germany and the Ohio State University in the USA have played a central role in developing cultivars with higher rubber content, more robust root systems and greater resistance to pests.[13] Extraction methods have also improved, moving from early manual processing to scalable enzymatic and mechanical techniques capable of meeting industrial demand.[14]

Continental AG has taken a global lead in this area through its Taraxagum project, launched in collaboration with the Fraunhofer Institute and other partners. In 2018, the company opened the Taraxagum Lab Anklam, a dedicated research facility in northeast Germany focused entirely on the development of dandelion rubber.[15] Since then, Continental has produced bicycle tyres, truck tyre treads and automotive engine mounts using dandelion latex, and it aims to integrate the material into mainstream tyre production as part of its broader sustainability strategy.[16] The company's efforts were recognised in 2021 when its dandelion rubber bicycle tyre won the German Sustainability Award for pioneering ecological innovation.[17]

Goodyear Tire and Rubber Company, meanwhile, has pursued complementary research through its longstanding BioIsoprene programme. Originally focused on synthetic biology and alternative rubber molecules, Goodyear has expanded its research into natural rubber sources, including the Russian dandelion.[18] In 2021, the company announced a partnership with the US Department of Defence and multiple academic institutions to trial dandelion rubber for military applications, including aircraft tyres, highlighting the strategic importance of domestic rubber production for national security.[19]

These efforts mark a shift in the commercial rubber landscape, where sustainability goals, climate resilience, and intellectual property rights are becoming just as important as yield and performance. With both Continental and Goodyear actively seeking patent protection for their innovations, the legal implications of biotechnological use of plant species, especially under UK, EU, and US IP regimes demand careful scrutiny.

III. Directive 98/44/EC: the EU approach to biotech patents

Directive 98/44/EC of the European Parliament and of the Council on the legal protection of biotechnological inventions forms the foundation of EU law on patentability in the field of biotechnology. Its adoption in 1998 was intended to harmonize the treatment of biotechnological inventions across Member States and to clarify the legal position concerning inventions involving living matter.

Article 3(1) of the Directive provides that inventions which are new, involve an inventive step and are susceptible of industrial application shall be patentable even if they concern a product consisting of or containing biological material, or a process by which such material is produced, processed or used.[20] Article 3(2) further affirms that biological material isolated from its natural environment, or produced by means of a technical process, may be patentable even if it previously occurred in nature.[21] This provision is particularly relevant to plant-derived products such as the latex extracted from *TK*, provided that the isolation and use involve a technical contribution beyond the discovery of the natural substance itself.

At the same time, Article 4 of the Directive introduces critical limitations. Article 4(1)(a) excludes from patentability plant and animal varieties as such, while Article 4(1)(b) prohibits patents for essentially biological processes for the production of plants or animals.[22] This distinction seeks to encourage technical innovation while preventing the privatization of natural processes and traditional agricultural knowledge. Notably, Article 4(2) clarifies that inventions which concern plants or animals may still be patentable if the technical feasibility of the invention is not confined to a particular plant or animal variety.[23]

9 Cornish (n 2) 1.
10 van Beilen and Poirier (n 3) 522.
11 Jos Barlow et al., 'Anthropogenic disturbance in tropical forests can double biodiversity loss from deforestation' (2016) 535 *Nature* 144–47.
12 Fraunhofer IME (n 4).
13 Ohio State University, 'Cornish Lab Research: Industrial Rubber from Plants'. Available at https://cornishlab.cfaes.ohio-state.edu/research (accessed 29 May 2025).
14 (Media explainer, 2020): 'Dutch Researchers Make Rubber from Dandelions' (Innovation Origins, 20 December 2020). Available at: https://innovationorigins.com/en/dutch-researchers-make-rubber-from-dandelions/ (accessed 29 May 2025).
15 Emma Georgiades, 'Continental Opens "Taraxagum Lab Anklam" Research and Test Laboratory for Dandelion Rubber' (8 December 2018) *European Rubber Journal*. Available at https://www.automotiveworld.com/news-releases/continental-opens-taraxagum-lab-anklam-research-and-test-laboratory-for-dandelion-rubber/ (accessed 29 May 2025).
16 Continental AG, 'Sustainable Materials: Natural Rubber from Dandelions'. Available at https://www.continental-tires.com/about/sustainability/activities-and-initiatives/design-and-sourcing/taraxagum/ (accessed 29 May 2025).
17 Continental AG, 'Continental Tire Made of Dandelion Rubber Wins German Sustainability Award' (4 December 2020). Available at https://www.continental.com/en/press/press-releases/2020-12-04-german-sustainability-award/ (accessed 29 May 2025).
18 Goodyear Tire & Rubber Company, 'Goodyear to Develop Domestic Source of Natural Rubber' (15 April 2021). Available at https://news.goodyear.com/goodyear-to-develop-domestic-source-of-natural-rubber (accessed 29 May 2025).
19 Air Force Research Laboratory, 'AFRL Teams with Industry to Expand Alternative Natural Rubber Supply' (15 December 2022). Available at https://www.afrl.af.mil/News/Article-Display/Article/3229274/afrl-teams-with-industry-to-expand-alternative-natural-rubber-supply/ (accessed 29 May 2025).
20 Directive 98/44/EC of the European Parliament and the Council of 6 July 1998 on the Legal Protection of Biotechnological Inventions [1998] OJ L213/13, art 3(1).
21 Ibid art 3(2).
22 Ibid art 4(1)(a), (b).
23 Ibid art 4(2).

These provisions have particular relevance to companies such as Continental and Goodyear, which are engaged in developing commercial uses for dandelion-derived rubber. Continental AG's patent EP 3275837 B1, for example, does not claim ownership over the Russian dandelion itself but instead protects a rubber composition containing bio-sourced polyisoprene derived from plants of the genus *Taraxacum*.[24] This aligns with Article 3(1) and 3(2) of the Directive, as the patent is directed towards a product created through a technical process, rather than the biological material in its natural state.

Had Continental attempted to patent a specific variety of *TK* developed through conventional breeding methods, such a claim would likely fall within the exclusion under Article 4(1)(a) and be rejected. However, should a variety result from genetic engineering or involve technical intervention in its development, it may fall within the patentable scope envisaged by Article 3, so long as it is not confined to a single variety and satisfies the other requirements of patentability.

The European Patent Office (EPO), though not an EU institution, interprets the European Patent Convention (the Munich Convention) (Munich, 5 October 1973) in line with the Biotech Directive in most cases. A series of decisions by the EPO Enlarged Board of Appeal have addressed the meaning of 'essentially biological processes'. In G 2/07 and G 1/08, concerning the *Broccoli* and *Tomato* cases, the Board held that processes involving only crossing and selection were unpatentable as they constituted essentially biological processes.[25] However, later cases such as G 2/12 and G 2/13 initially ruled that the products derived from such processes could still be patentable. This position was ultimately reversed in G 3/19, which confirmed that plants or animals obtained exclusively by essentially biological processes are themselves excluded from patentability, aligning the practice with Rule 28(2) EPC.[26]

For Goodyear, which operates primarily in the USA but may seek IP protection in Europe, the implications are equally significant. Any attempt to patent the cultivation of dandelions using traditional breeding methods would likely be excluded under Article 4(1)(b). However, patents focused on the technical process of latex extraction, or the industrial application of the rubber produced, would remain within scope provided they demonstrate novelty, an inventive step and industrial applicability.

Directive 98/44/EC thus creates a framework that supports the patenting of biotechnological applications involving plants, while excluding claims that would monopolize plant varieties or natural reproduction. For commercial innovators like Continental and Goodyear, the Directive underscores the importance of framing claims around technical processes or applications, rather than the plant itself. As bio-based innovation expands in response to environmental challenges, the boundaries set by the Directive will continue to shape the intersection of science, sustainability and IP.

IV. UK patent law post-Brexit: the Patents Act 1977

Despite leaving the EU, the UK remains a party to the European Patent Convention (EPC) and continues to enforce Directive 98/44/EC through domestic law, particularly via section 76A and Schedule A2 of the Patents Act 1977, implemented by the Patents Regulations 2000.[27] These statutory provisions ensure ongoing alignment with the EU's biotech patent regime.

Under section 1(2) of the Patents Act 1977, a patent cannot be granted for 'discoveries, scientific theories or mathematical methods' or methods of treating the human or animal body, while section 1(3) requires that any invention must be capable of industrial application. Significantly, section 76A and Schedule A2 replicate the Directive's exclusion of 'any variety of animal or plant' or 'any essentially biological process' for their production, unless they involve a microbiological or technical process, and maintain that inventions concerning plants or animals may be patentable if they are not confined to a specific variety.[28]

The United Kingdom Intellectual Property Office (UKIPO), through its *Manual of Patent Practice*, confirms that biological material in its natural state cannot be patented, but that material isolated or processed by technical means, or formulated into industrial applications, may be eligible.[29] The UKIPO manual specifies that claims to a product containing biological material are not excluded from patentability solely because of its origin, provided that it is isolated through a technical process or used in a technical context.[30]

This understanding aligns with definitive rulings for the EPO. In G2/07 and G1/08, the *Broccoli* and *Tomato* cases, the Enlarged Board held that non-microbiological processes consisting solely of crossing and selection, even when supported by technical tools, are 'essentially biological' and thus excluded from patentability under Article 53(b).[31] The later G3/19 (*Pepper*) decision went further, clarifying that plants or plant materials obtained exclusively by such processes are also unpatentable, a legal position now captured in Schedule A2(3)(f) of the UK's Patents Act 1977.

In contrast to the European approach, US patent law has been more permissive in allowing patents on living organisms, including plants. The landmark case of *Diamond v Chakrabarty* established that a genetically modified bacterium capable of breaking down crude oil was patentable subject matter because it was 'a non-naturally occurring manufacture or composition of matter'.[32] Subsequently, in *JEM Ag Supply Inc v Pioneer Hi-Bred International Inc*, the Supreme Court confirmed that newly developed plant breeds are patentable under the general utility patent provisions of the US Patent Act, even though separate statutory regimes exist for plant patents and plant variety protection.[33] The United States Patent and Trademark Office (USPTO) therefore permits patents not only on processes involving plants, but in some cases on the plants themselves where they are novel, non-obvious and useful.[34] This broader protection contrasts sharply with the EU position, which excludes plant varieties and essentially biological processes from patentability.

While the Withdrawal Act 2018 preserves pre-2021 EU law in the UK, actual divergence remains unlikely in the near term. Any

[24] EP 3275837 B1 (n 8).

[25] EPO Enlarged Board of Appeal, G 2/07 (*Broccoli*) [2010] OJ EPO 304; G 1/08 (*Tomato*) [2010] OJ EPO 307.

[26] EPO Enlarged Board of Appeal, G 3/19 (*Pepper*) [2020] OJ EPO A118; Rule 28(2) of the European Patent Convention 2000 (EPC).

[27] Patents Act 1977 (as amended), s 76A, Sch A2 (via Patents Regulations 2000 SI 2000/2037).

[28] Patents Act 1977, Sch A2(3)(f); World Intellectual Property Organization, 'IP and Development Flexibilities', available at https://www.wipo.int/ip-development/en/agenda/flexibilities/ (accessed 29 May 2025).

[29] UK Intellectual Property Office, *Manual of Patent Practice*, s 76A (updated September 2023). Available at https://www.gov.uk/guidance/manual-of-patent-practice-mopp/section-76a-biotechnological-inventions (accessed 29 May 2025).

[30] Ibid, paras 76A.07–76A.09.

[31] The European Patent Convention (adopted 5 October 1973, entered into force 7 October 1977) 1065 UNTS 199, art 53(b).

[32] *Diamond v Chakrabarty* 447 US 303 (1980).

[33] *JEM Ag Supply Inc v Pioneer Hi-Bred International Inc* 534 US 124 (2001).

[34] US Patent Act 35 USC §§ 101–103; see USPTO, General Information Concerning Patents (USPTO 2020).

legislative deviation would require explicit policy action, potentially in response to environmental and agricultural interests, but, so far, the UK continues to mirror EU and EPO practice.[35]

For companies such as Continental and Goodyear, the current legal framework provides certainty: while a plant itself in its natural form may not be patentable, inventions involving technical processes to extract or process plant-based materials, such as isolating polyisoprene from dandelion roots and incorporating it into an industrial rubber compound, can be patentable.

As discussed earlier, both EU and UK law draw a clear line between discoveries of natural processes and patentable technical inventions. Companies such as Continental and Goodyear have operated within this legal framework by securing protection not for the plant itself, but for the methods of extracting and industry applying the rubber compound derived from the Russian dandelion.

V. Case application: Continental and Goodyear

The commercialization of *TK* provides a case study with which to test the limits of European and UK patent law. While Article 53(b) of the European Patent Convention (EPC) and Schedule A2 of the Patents Act 1977 exclude plant varieties and essentially biological processes from protection, patents directed at downstream processes and compositions remain available. Continental AG and Goodyear Tire & Rubber Company, as industry leaders, exemplify how large firms structure portfolios to enclose the value chain from root to rubber while formally respecting doctrinal exclusions. This section unpacks their strategies and assesses the doctrinal, institutional and policy implications.

A. Continental: composition and process claims under the EPC framework

Continental has centred its European filings on compositions and methods rather than the plant itself. Its granted European patent EP 3275837 B1claims a rubber composition for pneumatic tyres comprising bio-sourced polyisoprene derived from plants of the genus *Taraxacum*.[36] By situating the claim at the composition level, Continental ensures compliance with Directive 98/44/EC, arts 3(1) and (2), which explicitly allow patenting of biological material once isolated from its natural environment or produced by technical means. A related German application discloses methods of processing TK roots to obtain latex with industrially useful qualities.[37]

Doctrinally, this reflects the distinction between unpatentable discovery and patentable invention.[38] The plant itself cannot be claimed, but once the latex is extracted, purified and incorporated into a technical composition, the invention is eligible. Dutfield notes that this doctrinal structure was intentional: the Biotech Directive sought to encourage investment in biotechnology while preserving the public domain for natural varieties.[39] Yet the practical effect is asymmetrical: although the plant remains formally unpatentable, the main avenues of commercial exploitation are subject to proprietary control.

Continental's filings are reinforced by institutional investments. The company established the Taraxagum Lab Anklam in Germany in 2018, a dedicated research facility that anchors its patent portfolio with infrastructure and scientific partnerships.[40] As Jeddeloh et al. demonstrate, *TK* is now in an 'application broadening' stage of its technological life cycle: after initial emergence, patenting activity accelerates, applications diversify and clustering benefits incumbents.[41] This means Continental's position is not simply the result of individual patents but of a portfolio-plus-infrastructure strategy that consolidates its dominance and may deter latecomers.

B. Goodyear: US subject-matter permissiveness and global expansion

Goodyear has approached *TK* through a US-centric strategy. US Patent 10,669,134 protects a rubber composition and tyre comprising polyisoprene obtainable from *TK* latex. This reflects the more permissive subject-matter standard in the USA, where *Diamond v Chakrabarty* held that 'anything under the sun that is made by man' is patentable, including genetically modified organisms,[42] and *JEM. Ag Supply Inc v Pioneer Hi-Bred* confirmed that newly developed plants may fall within the utility patent system.[43] Unlike the EPC, which excludes plant varieties, US law enables claims framed as compositions or manufactures to capture a wider range of plant-related inventions.

Goodyear has also pursued international protection. Through the Patent Cooperation Treaty (PCT) it has filed applications, including WO 2020/111161 A1, designating Europe and Asia.[44] This reflects the global nature of *TK* as a prospective supply chain input. Minssen and Nilsson note that careful claim drafting is a central feature of biotechnology portfolios: even after restrictive US Supreme Court rulings in *Mayo* and *Myriad*, well-crafted composition claims can often navigate eligibility hurdles.[45] Goodyear's approach exemplifies this tactic, targeting industrial applications rather than the plant itself.

VI. Doctrinal implications: testing the exclusions

A. Exclusions on plants and processes principles but permeable

European exclusions on plant varieties and essentially biological processes have been affirmed in G 2/07 (*Broccoli*), G 1/08 (*Tomato*) and G 3/19 (*Pepper*).[46] Yet Continental and Goodyear demonstrate how claims may be structured to focus on technical steps and compositions, thereby avoiding the exclusions while capturing the value chain. The plant remains outside patentability, but the inventions that make it economically useful do not.

[35] European Union (Withdrawal) Act 2018, s 2; Venner Shipley, 'Brexit and IP updates 2025', available at https://www.vennershipley.co.uk/insights-events/brexit-and-ip-updates-2025/ (accessed 29 May 2025).

[36] EP 375837 B1 (n 8).

[37] Deutsches Patent—und Markenamt, DE 102013107279 A1, 'Rubber material based on Russian dandelion' (Continental AG, filed 2013).

[38] William Cornish et al., *Intellectual Property: Patents, Copyright, Trade Marks and Allied Rights* (9th edn Sweet & Maxwell 2019) 288–93.

[39] Graham Dutfield, *Intellectual Property Rights and Life Science Industries: Past, Present and Future* (2nd edn Routledge 2009) 119–23.

[40] Georgiades (n 15).

[41] Sonja zu Jeddeloh et al., 'The Dandelion Rubber Effect: Life Cycle and Patenting Locations in New Technologies—Investigating German Bioeconomy' (2025) 35 *Journal of Evolutionary Economic* 471–512, 472–74.

[42] *Chakrabarty* (n 32).

[43] *JEM Ag Supply* (n 33).

[44] World Intellectual Property Organisation, WO 2020/111161 A1 'Rubber Composition and Tire' (Goodyear Tire & Rubber Co 2020).

[45] Timo Minssen and David Nilsson, 'Standing on Shaky Ground: US Patent-Eligibility of Isolated DNA and Genetic Diagnostics after *AMP v USPTO*—Part III (Unsolved Questions & Subsequent Case Law)' (2012) 2 *Queen Mary Journal of Intellectual Property* 225–49, 226–28.

[46] EPO Enlarged Board of Appeal, G 2/07 (*Broccoli*) [2010] OJ EPO 304; G 1/08 (*Tomato*) [2010] OJ EPO 307; G 3/19 (*Pepper*) [2020] OJ EPO A118.

B. Hybrid governance and interpretive seams

Aerts highlights that EU biotechnology patenting is governed by a hybrid system: substantive norms derive from Directive 98/44/EC, but patents are granted by the EPO, which is not bound by the Court of Justice of the European Union (CJEU).[47] This produces interpretive friction, visible in the decade-long evolution from *Broccoli/Tomato* to *Pepper*. Applicants can exploit this uncertainty by framing claims strategically. Continental's filings exemplify this: framed as technical compositions, they fall comfortably within EPO practice, even if doctrinal debates about plant patentability persist.

C. Portfolio-level enclosure

A significant risk lies not in individual patents but in the aggregation. As Stolze et al. demonstrate, metabolic engineering of *TK*, such as overexpressing 1-FEH to double root latex yield, can significantly improve commercial viability.[48] Such interventions are patent-eligible technical processes. When combined with composition and processing patents, these can create patent thickets that restrict freedom to operate. The law's doctrinal exclusions prevent ownership of the plant variety but do not stop functional enclosure through portfolios.

D. Comparative divergence and forum shopping

US law remains more permissive in granting patents on plant-derived products, even after *Mayo* and *Myriad*.[49] Applicants such as Goodyear can therefore draft broad composition claims in the USA while aligning narrower technical claims with Directive 98/44/EC in Europe, and then consolidate protection via PCT filings. This jurisdictional optimization invites forum shopping and creates transaction costs for technology transfer, concerns that have long been raised in critical IP scholarship.[50]

VII. Critical assessment

The Continental and Goodyear portfolios illuminate the practical consequences of Europe's doctrinal exclusions. While the law prevents direct monopolization of plant varieties, the commercial reality is that patents on extraction methods, engineered traits and industrial compositions capture much more of the value. This outcome complies with the letter of Directive 98/44/EC but raises questions about whether the balance between incentivizing innovation and safeguarding access is truly being maintained.

Institutional clustering at Anklam, advances in metabolic engineering and global portfolio strategies suggest *TK* rubber is evolving into a technology dominated by a few incumbents. In this respect, the plant may remain free, but the innovation space around it risks enclosure. The doctrinal framework is therefore at once principled and permeable: principled in excluding plants themselves and permeable in allowing dense portfolios to capture the practical benefits. This tension makes dandelion rubber a litmus test for the adequacy of current IP law in managing sustainable biotechnologies.

VIII. Implications for UK patent law

Although the UK has left the EU, it remains a contracting state to the European Patent Convention 1973. This ensures that jurisprudence of the European Patent Office (EPO), including decisions of the Enlarged Board of Appeal on biotechnological inventions, continues to shape practice before the UKIPO and the courts.[51] In particular, cases such as *G 2/07 (Broccoli)*, *G 1/08 (Tomato)* and *G 3/19 (Pepper)* have been incorporated into the UKIPO's *Manual of Patent Practice*, which affirms that plants obtained exclusively by essentially biological processes are unpatentable.

However, Brexit has altered the institutional landscape in important ways. The UK chose not to participate in the new Unified Patent Court (UPC) and Unitary Patent system, which launched in 2023 for participating EU Member States.[52] As a result, patent applicants must continue to designate the UK separately when seeking European protection, increasing administrative costs and potentially creating legal divergence in the long term. For industries such as biotechnology and sustainable materials, this dual system raises the possibility of inconsistent enforcement outcome between the UPC and UK courts, particularly if future case law on plant-related inventions develops differently.[53]

At present, substantive divergence remains limited. The European Union (Withdrawal) Act 2018 preserves EU-derived law, including the Biotech Directive 98/44/EC, as 'retained EU law' within the UK.[54] Parliament has not signalled any immediate intention to depart from this framework, and the UKIPO continues to apply Directive-consistent reasoning. Yet the legal capacity for divergence now exists. Should the UK seek to position itself as a more innovation-friendly jurisdiction post-Brexit, there may be pressure to reconsider the balance between protecting biotechnological inventions and safeguarding the public domain.[55] This debate is especially salient in areas like dandelion rubber, where the technology aligns closely with government priorities on sustainability, green innovation and industrial strategy.

Policy commentators note that the UK's independence from EU structures could allow it to recalibrate its approach to agricultural biotechnology, for example by aligning more closely with the broader US model of patentability.[56] Such a shift would be controversial: while it might attract investment, it could also generate tensions with the UK's commitments under the Convention on Biological Diversity (the Biodiversity Convention; CBD) (Rio de Janeiro, 5 June 1992 to 4 June 1993) and Nagoya Protocol, as well as with trading partners in the EU. The alternative path is continuity: retaining harmonization with EPO and EU practice, the UK is likely to continue to 'shadow' EU jurisprudence in biotechnology, at least in the medium term, given the advantages of consistency in a field dominated by multinational actors.

47 RJ Aerts, 'Biotechnology Patenting Caught between Union Law and EPC Law: European Bundle Patents, Unitary Patents and International Harmonisation of Decisions in the Internal Market' (2016) 6 QMJIP 287, 288–92.

48 A Stolze et al., 'Development of Rubber-Enriched Dandelion Varieties by Metabolic Engineering of the Inulin Pathway' (2017) 15 *Plant Biotechnology Journal* 740, 743–45.

49 *Association for Molecular Pathology v Myriad Genetics Inc* 569 US 576 (2013); *Mayo Collaborative Services v Prometheus Laboratories Inc* 566 US 66 (2012).

50 Michael Blakeney, 'Climate Change and Gene Patents' (2012) 2 *Queen Mary Journal of Intellectual Property* 1–24, 7–10.

51 UKIPO, *Manual of Patent Practice*, s 76A. Available at https://www.gov.uk/guidance/manual-of-patent-practice-mopp/section-76a-biotechnological-inventions (accessed 29 May 2025).

52 European Patent Office, 'Unitary Patent and Unified Patent Court'. Available at https://www.epo.org/applying/european/unitary.html (accessed 29 May 2025).

53 Luke McDonagh, 'The Unitary Patent System and the UK: Divergence after Brexit?' (2021) 43 *European Intellectual Property Review* 16.

54 European Union (Withdrawal) Act 2018, s.2.

55 Charlotte Waelde and Abbe Brown, *Contemporary Intellectual Property: Law and Policy* (6th edn OUP, 2021) 318–320.

56 Peter Yu, 'The Objectives and Principles of the TRIPS Agreement' (2009) 46 Houston Law Review 979, 1012–1018.

IX. Policy and ethical debate

The question of patenting plants also raises broader policy and ethical concerns. Critics argue that allowing IP rights over naturally occurring organisms risks the 'commodification of nature' and may restrict access to essential resources, particularly in the Global South.[57] Others contend that patents provide crucial incentives for innovation in sustainable technologies, encouraging investment in research that might not otherwise be commercially viable.[58]

This debate is not confined to academic commentary. Scholars such as Graham Dutfield have highlighted the tension between promoting biotechnology innovation and safeguarding biodiversity, noting the risks that expansive patenting may pose for equitable access and global sustainability.[59] Similarly, the European Commission has repeatedly emphasized in policy papers that IP must be deployed in ways consistent with environmental objectives and the European Green Deal, underlining the need for balance between exclusive rights and public interest.[60]

The European framework, by permitting patents on technical processes but excluding the plants themselves, attempts to strike a balance between these competing concerns.[61] The dandelion rubber example illustrates both the promise of such innovation and the tensions that arise when the law seeks to support sustainability without overprivatizing nature.

X. International development, biodiversity and access

The question of patenting plants cannot be separated from broader debates about global equity in access to biological resources and the fair distribution of benefits arising from their commercialization. While companies in the Global North, such as Continental and Goodyear, have led the way in dandelion rubber research, the underlying plant genetic resources are part of a shared natural heritage that extends well beyond European laboratories and test fields. This raises difficult issues of biopiracy, benefit-sharing and compliance with international biodiversity instruments.

The CBD 1992 established the principle that states have sovereign rights over their biological resources, rejecting the earlier assumption that genetic materials were a common heritage of humankind.[62] The CBD was complemented by the Nagoya Protocol on Access and Benefit-Sharing (2010), which requires parties to ensure that access to genetic resources is subject to prior informed consent and that benefits are shared fairly with provider countries and local communities.[63] Although the Russian dandelion originates primarily from Central Asia, its commercial exploitation in Europe highlights how biotech innovation can easily be decoupled from the communities and ecosystems where genetic resources are sourced.

For developing countries, this has two key implications. First, it raises concerns that biotechnological patents granted in Europe or North America could restrict their ability to use similar resources domestically without infringing foreign rights.[64] Second, it intensifies the debate over whether international IP frameworks, particularly the TRIPS Agreement 1994, are sufficiently flexible to accommodate biodiversity and development objectives. While TRIPS article 27(3)(b) allows members to exclude plants and animals from patentability, it obliges them to provide some form of protection for plant varieties, usually via plant variety rights.[65] This creates tension between North–South perspectives: developed states favour stronger patent protection, while developing states emphasize farmers' rights and traditional knowledge.[66]

The World Intellectual Property Organisation (WIPO) Intergovernmental Committee on Intellectual Property and Genetic Resources, Traditional Knowledge and Folklore (IGC) has, for over two decades, attempted to broker consensus on these issues.[67] Progress remains slow, but the dandelion rubber case demonstrates why such debates are not purely academic. If alternative rubber production were to be expanded globally, questions of access and benefit-sharing could resurface, particularly if Central Asian states asserted rights over germplasm originally collected from their territories.

Another concern is whether the proliferation of patents on extraction and processing methods may create 'patent thickets' that hinder technology transfer to the Global South.[68] This is especially problematic where sustainable materials are concerned: if green technologies become overprivatized, the capacity of developing states to meet climate and biodiversity goals may be undermined. The Doha Declaration on the TRIPS Agreement and Public Health (2001) affirmed the right of World Trade Organisation members to interpret TRIPS in ways supportive of public health.[69] A similar interpretative emphasis could be argued for biodiversity and sustainability: IP law should be construed to support, rather than hinder, the achievement of the UN Sustainable Development Goals.[70]

Against this backdrop, the EU and UK's approach, excluding plants and essentially biological processes, while permitting patents on technical interventions, can be seen as a partial safeguard against overappropriation. By refusing to allow ownership of the plant itself, the law preserves some degree of access for other users and researchers worldwide. At the same time, the granting of patents on downstream applications ensures that commercial incentives remain in place for private actors to invest. This balance may be fragile, but it offers a model of how IP systems can integrate development and environmental concerns more explicitly than the broader US model.

[57] Vandana Shive, *Biopiracy: the Plunder of Nature and Knowledge* (South End Press 1997).

[58] William Cornish et al., *Intellectual Property: Patents, Copyright, Trade Marks and Allied Rights* (9th edn Sweet and Maxwell 2019) 272–73.

[59] Graham Dutfield, *Intellectual Property Rights and the Life Science Industries: Past, Present and Future* (2nd edn Routledge 2009) 158–61.

[60] European Commission, Intellectual Property Action Plan to Support the EU's Recovery and Resilience COM (2020) 760 final, 25 November 2020, 6–7.

[61] Directive 98/44/EC of the European Parliament and the Council on the Legal Protection of Biotechnological Inventions [1998] OJ L213/13.

[62] Convention on Biological Diversity (adopted 5 June 1992, entered into force 29 December 1993) 1760 UNTS 79, art 3.

[63] Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilisation to the Convention on Biological Diversity (adopted 29 October 2010, entered into force 12 October 2014) UN Doc UNEP/CBD/COP/DEC/X/1.

[64] Carlos Correa, *Trade Related Aspects of Intellectual Property Rights: a Commentary on the TRIPS Agreement* (OUP 2007) 347–55.

[65] Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS Agreement) (adopted 15 April 1995, entered into force 1 January 1995) 1869 UNTS 299, art 27(3)(b).

[66] Peter Yu, 'The Objectives and Principles of the TRIPS Agreement' (2009) 46 *Houston Law Review* 979, 1012–18.

[67] Daniel Robinson et al. (eds), *Protecting Traditional Knowledge: the WIPO Intergovernmental Committee on Intellectual Property and Genetic Resources, Traditional Knowledge and Folklore* (Routledge 2017)

[68] UNCTAD, *Trade and Environment Review 2013: Wake Up Before It Is Too Late* (2013) 86–90.

[69] WTO, 'Doha Declaration on the TRIPS Agreement and Public Health' WT/MIN(01)/DEC/2 (20 November 2001).

[70] United Nations, Transforming Our World: the 2030 Agenda for Sustainable Development UN Doc A/RES/70/1 (25 September 2015).

Ultimately, the international dimension underscores the political stakes of plant patentability. As climate change intensifies the search for alternative materials, disputes over ownership of genetic resources are likely to increase. The Russian dandelion illustrates both the promise of innovation and the risks of inequitable appropriation. Future reforms to TRIPS, the CBD and WIPO's ongoing negotiations will determine whether global IP law evolves into a tool that promotes sustainable development, or a mechanism that entrenches disparities between North and South.

XI. Conclusion

The development of dandelion-derived rubber represents a convergence of environmental urgency, scientific innovation and legal complexity. As companies like Continental and Goodyear seek to commercialize alternative rubber sources, they do so within a nuanced legal landscape that draws a careful distinction between unpatentable natural discoveries and patentable technical interventions. The European and UK frameworks, shaped by Directive 98/44/EC, the European Patent Convention and evolving jurisprudence, permit protection not of the plant itself, but of the inventive methods and industrial applications derived from it.

The distinction is far from academic. In practice, it enables innovation in green technologies while preventing the monopolization of nature. As the UK continues to recalibrate its legal frameworks post-Brexit, the treatment of plant-based inventions and biotechnological processes will serve as a litmus test for the country's approach to balancing innovation, sustainability and access. The dandelion rubber case study not only underscores the adaptive potential of IP law but also highlights its crucial role in shaping the future of environmentally responsible commercial development.

The case of dandelion rubber highlights the nuanced position of UK and EU law: the plant itself cannot be the subject of a patent, but innovative technical processes surrounding it can. This approach reflects a deliberate balance between incentivizing industrial innovation and protecting the public domain. Compared with the broader US model, the European system arguably places greater emphasis on the ethical limits of IP. From a policy perspective, this balance will be increasingly important as legal systems confront the challenges of climate change, biodiversity loss and the urgent need for sustainable technologies.

Journal of Intellectual Property Law & Practice, 2026, **00**, 1–7
https://doi.org/10.1093/jiplp/jpaf080
Article