

The patent landscape behind the Nobel Prize awarded to CRISPR

The 2020 Nobel Prize in Chemistry was awarded to Jennifer Doudna and Emmanuelle Charpentier in October for their work on the gene editing tool CRISPR/Cas 9, commonly referred to as CRISPR. This Nobel Prize does not come without some controversy. Not only are the winners involved in a patent dispute relating to CRISPR, where Doudna's and Charpentier's interests are represented by the University of California while Feng Zhang, on the other side of the patent dispute, is active at The Broad Institute of MIT and Harvard and was notably not included in the award by the Nobel committee.

The top 15 organisations patenting CRISPR related technologies are primarily universities, indicating that commercial applications of CRISPR remain underdeveloped. There are, however, commercial organisations such as DuPont De Nemours and Regeneron Pharmaceuticals focused on producing comparatively small yet technologically important patent portfolios, which will ensure their position when this technology becomes more widely used beyond research. Currently, for example, CRISPR is used in clinical trials and is expected to have a massive impact on agriculture. CRISPR altered apples were sold in the US back in 2017, and many more applications are in the works.

According to their PVIX score¹, University of California has a comparatively smaller, less technologically important granted portfolio compared to that of MIT and The Broad Institute.

Key Findings

- The potential of CRISPR is undisputed, but who controls the patent assets?
- Although universities are still in control of some of the largest patent portfolios relating to the CRISPR tool, commercial organisations are actively using and patenting this technology.
- DuPont De Nemours and Regeneron Pharmaceuticals have comparatively small portfolios, but they are equally as important to the Harvard, MIT and Broad Institute portfolios.

What is CRISPR/Cas 9?

CRISPR is a gene editing tool which offers higher precision than ever before. Gene editing allows you to manipulate genes by adding, deleting and substituting specific sequences of DNA or even an entire gene into an exact location in a genome. It is not only more accurate, but also quicker and cheaper than tools used before.

Doudna and Charpentier did not discover CRISPR/Cas 9, but were instrumental in turning it into the useful artificial tool it is today. Yoshizumo Ishino discovered CRISPR in 1987 and Francisco Mojica characterized the CRISPR sequence in 1993. It was not until mid-2000s that researchers discovered CRISPR was a part of the immune system.

¹ A PVIX score, as developed by Unified Patents, is assigned to each portfolio based on three components: (i) Family - number of active patent families in the portfolio, (ii) Market - number of jurisdictions in which each family is granted, and (iii) Reputation - number of forward citations each family has received. It is intended to measure patent portfolio value, quality and importance. The PVIX score only includes the granted patent families.

CRISPR has already been used in clinical trials for treating breast cancer and genetic disorders, it has been FDA approved for use in Covid-19 tests and is being used in research to find a way to eradicate malaria by editing the genome of mosquitoes. CRISPR is also used to genetically modify crops.

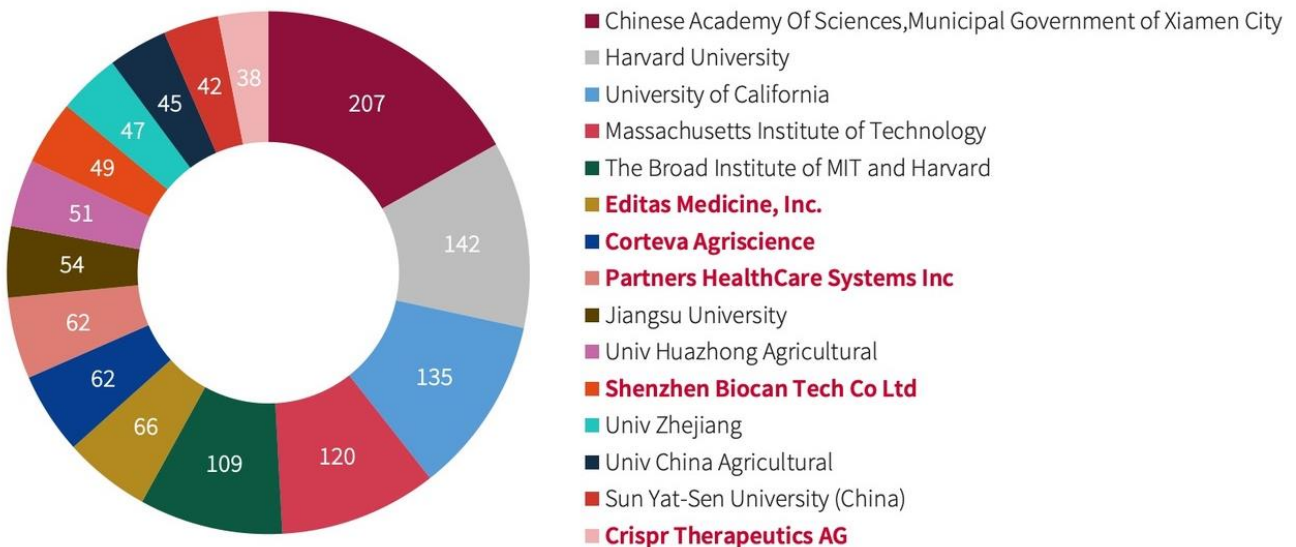
The above-mentioned patent dispute does not appear to be discouraging the use of the CRISPR technology; patents are being filed and the technology continues to be used in research both by universities and commercial organisations. Although universities are still in control of some of the largest patent portfolios relating to the CRISPR tool, commercial organisations are actively using and patenting this technology.

The potential of CRISPR is undisputed, but who controls the CRISPR patent assets?

Who controls the CRISPR patent assets?

The global patent landscape is dominated by research institutes with 10 out of the top 15 patent owners being universities or research institutes. The 5 commercial institutes are Editas Medicine, Corteva Agriscience, Partners HealthCare Systems, Shenzhen Biocan Tech Co and Crispr Therapeutics. The top 15 patent owners control 23% of the patent assets of the CRISPR landscape. The research institutes include The Broad Institute, MIT and University of California, all involved in the aforementioned patent dispute.

Chart 1: Active patent families, by organisation



Source: CIPHER

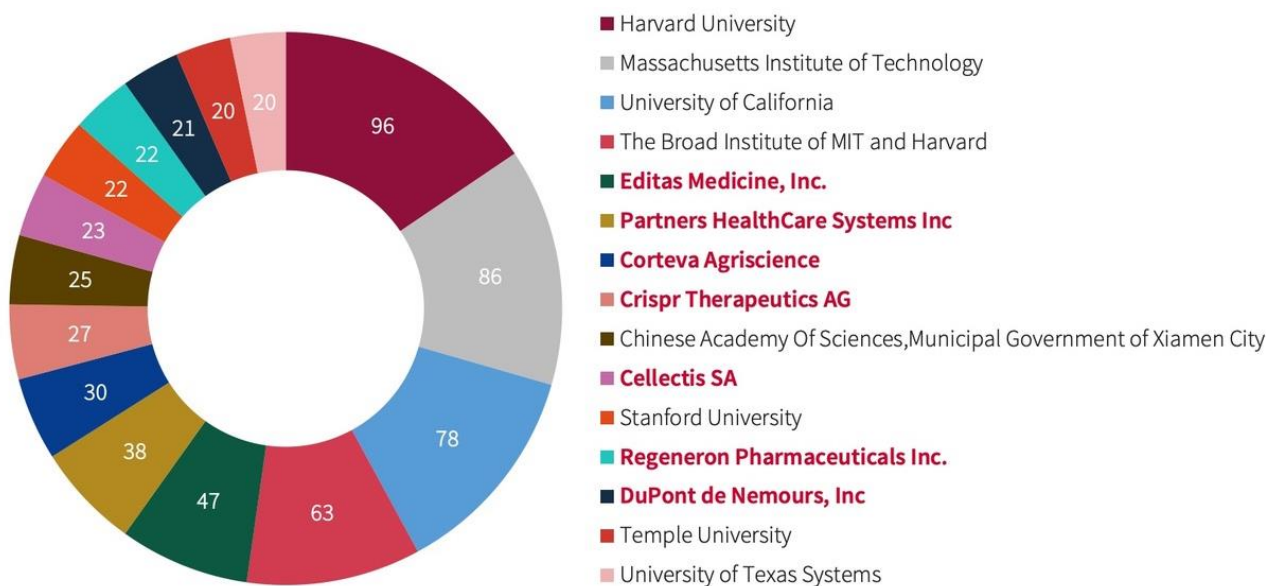
The European and North American landscape looks slightly different, with 8 out of the top 15 asset holders being research institutes, with DuPont de Nemours, Regeneron Pharmaceuticals and Cellectis making the top 15. This arguably indicates a larger future implementation of commercial CRISPR products in Europe and North America compared to Asia. However, this could change quickly as many of the global top patent owners are Asian and it is unlikely the importance of this technology will have been missed.

Some of the organisations seen here are active in the agricultural industry (e.g. DuPont de Nemours and Corteva) and this industry might soon be able to make use of CRISPR generated products more broadly. This may be a result of the fact that both DuPont de Nemours and The Broad Institute announced in 2017 that they would jointly provide non-

exclusive licenses to foundational CRISPR-Cas9 patents for use in commercial agricultural research and product development. Initiatives such as this which enable further research and developments would have an impact on the research landscape. Although there are various hurdles to overcome in different jurisdictions to produce, for example CRISPR altered crops, and to make them widely available in the grocery store, CRISPR is likely to revolutionise how we eat. Along with apples which do not brown already available to US consumers, many other CRISPR altered food products are in the works. While some applications aim to satisfy consumer needs such as mushrooms and apples that don't brown and gluten free wheat, others aim to benefit the farmer such as disease resistant crops. It is not surprising that the first CRISPR altered crops have been introduced in the US and not Europe as the GM laws, which CRISPR altered crops are subject to, are very tough in the EU. This is also reflected in the patent landscape – most patents in this landscape are active in North America and Asia, with fewer in Europe.

Other corporations such as Partners HealthCare, Crispr Therapeutics and Editas are more focused on the use of CRISPR to combat disease. Currently, clinical trials using CRISPR are being conducted although no drugs or treatments are available to consumers or patients. There are, however, questions regarding the feasibility of these treatments and drugs as they have so far shown to be expensive to produce. Indeed, some US insurance companies such as VantageBlue from Blue Cross Blue Shield of Rhode Island, Select Health, and VIVA Health have chosen to exclude gene therapy from coverage. This may establish a policy against paying for CRISPR-based therapeutics which will further complicate the implementation.

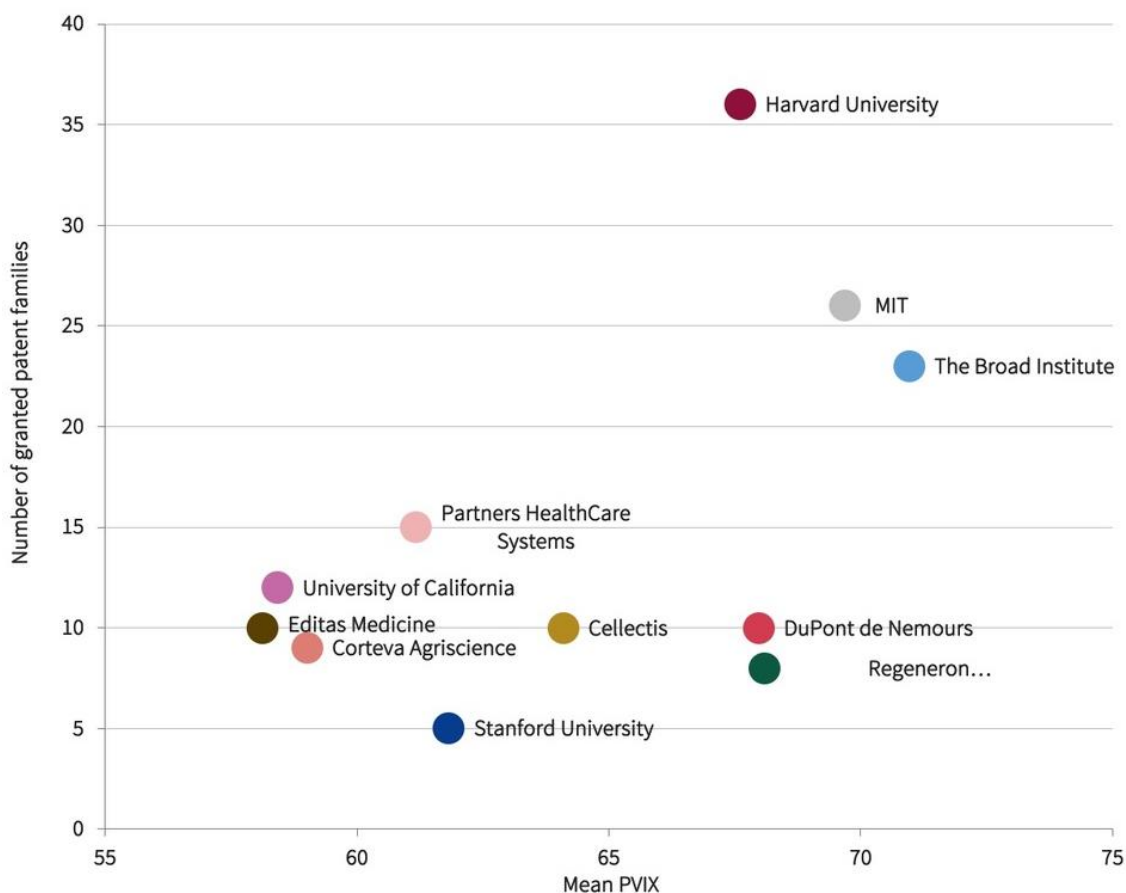
Chart 2: Active patent families, by organisation - Europe & North America



Source: CIPHER

DuPont de Nemours filed CRISPR related inventions as early as 2005, whilst the other top 15 patent owners didn't start filing until 2012 which was the same year that Doudna and Charpentier first published evidence that the CRISPR system could cut targeted DNA.

Chart 3: PVIX Score vs Granted Portfolio Size – top 15 Europe & North America



Source: CIPHER

The PVIX score or Portfolio Value Index score is a metric intended to measure patent portfolio value, quality and importance.

Despite holding one of the earliest patents, DuPont de Nemours have not reached the same volume of patents as other organisations. They remain, however, of great importance with a PVIX score to match the larger patent portfolios of Harvard, MIT and The Broad Institute. Several universities and organisations have been credited for holding foundational CRISPR patents, two of them are Collectis and DuPont de Nemours.

Both DuPont De Nemours and Regeneron Pharmaceuticals have comparatively small portfolios, but they are equally as important to the Harvard, MIT and Broad Institute portfolios according to the score. University of California, where Nobel Prize winner Doudna conducts research on CRISPR, has a comparatively low PVIX score, despite her work being recognised for its importance and the patents being disputed in court. It should, however, be noted that a majority of the University of California CRISPR patents are currently pending and only the granted portfolio is assigned a PVIX score. The image can change when more patents are granted.

Time will tell how this technology develops, how it's implemented in the future and what effects the results of ongoing patent disputes will have on the future of CRISPR. CRISPR is still not widely commercialised. However, several corporations are innovating and building patent portfolios using this tool. Although the size of them are still relatively small, they have shown to be technologically important. This indicates a future where people are benefitting

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from the tool in the shape of both crops and pharmaceuticals. At this point it appears crops is where we will first see the benefits and perhaps more likely in the US rather than in Europe due to differences in legislations regarding genetically altered foods. There is also investment into the use of CRISPR in treatments of disease, but we might need to wait a bit longer before we see these solutions being offered to those in need.

For more information on who owns what and where in the CRISPR space, access CIPHER via your subscription or if you'd like to understand more about the FinTech taxonomy used to run this report in CIPHER, contact us directly at www.cipher.ai.

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