

Patent Mapping Of Disease Resistance Genes in Tobacco

K. Prabhakara Rao*, K. Sarala and T.G.K. Murthy

ICAR-Central Tobacco Research Institute, Rajahmundry-533 105, India.

Abstract

Online mapping tools are employed for collecting information about the patents on disease resistance genes of tobacco. A total of 124 patent documents were retrieved from different web resources. Analysis of Patenting activity in disease resistance genes especially in tobacco is initiated in 1992 and there is considerable progress in patenting from the year 2000 and it was more prominent from 2010 onwards. Majority of these patent documents (around 60%) are in the jurisdiction of United States of America (USA) and China. US Smokeless Tobacco Company and Syngenta Participations are the two private firms holding majority of the patents. In public sector, University of Kentucky Research Foundation and University of California have more patents than other public sector institutes. Dr. Xu Dongmei and Dr. Nielsen currently working with US Smokeless Tobacco Company have active profile in patenting of disease resistance genes in tobacco.

*Corresponding Author:

K. Prbhakara Rao

Email: prabhakarabt@yahoo.co.in

Received: 10/03/2016

Revised: 07/05/2016

Accepted: 09/05/2016

Key words: Tobacco, Patents, Disease resistance, Mapping.

1. Introduction

Tobacco is an important commercial crop grown in many parts of the world. As in other crops, bacterial, viral and fungal diseases are limiting the productivity of the tobacco crop at farm level. Researchers are developing various disease management strategies for minimizing crop yield losses at field level. This include development of disease resistant varieties through conventional breeding and biotechnological interventions. The advances in biotechnology and bioinformatics generated handful of genome based tools, techniques, genes and gene constructs in the field of plant disease resistance (Dangl and Jones, 2001). The intellectual information generated in these frontier areas is available in non-patent and patent literature. Non-patent literature (NPL) consists not only of peer-reviewed scientific papers but also includes other types of publications: conference proceedings, databases (DNA structures, gene sequences, chemical compounds, etc.) and other relevant literature (translation guides, statistical manuals, etc.). Patent documents provide detailed information about an invention. These documents form part of the technical knowledge in the public domain, often kept in public libraries, databases or other media all over the world. They constitute an enormous resource of technological information. In order to access the technical information available in patent document, it is very necessary to know about the different sources of patent

information. Every year, about one million patent documents are estimated to be added to the existing ones (WIPO, 2011). Nearly 80% of all the technical information available in the world is hidden in the patent documents and other IP assets. Patent mapping is a bioinformatic tool that helps in retrieving and exploring the information protected in the intellectual properties documents.

The understanding, interpretation and use of patent document depend on the purpose for which patent information is needed. Collections of patent documents are available in a number of patent information databases. Patent information can be used to see whether a new invention is eligible for grant of a patent. The information available from the patent document is helpful in avoiding re-inventing the wheel. The description of the patent document helps in learning about the current state of the art in a given field of technology. It also helps in finding the latest trends in R and D being pursued by the peers and competitors. Further, it facilitates routes to gain access to applied technologies through licensing or purchase. Additionally, by studying the patent documents, it is possible to monitor the research and commercial directions of any company or inventor in the field of technology. The patent applications are filed earlier than publishing the paper in any journal, as any publishing could be subject of prior art and lead to the subject of disqualification of the patenting. People may

unknowingly infringe the patents. Patent search can be done to avoid such type of infringement.

Patent mapping of disease resistance genes in tobacco will aid in elucidation of concealed information on patented genes of disease resistance and helps in vigilant designing of crop improvement strategies (Japan Patent Office, 2011). In the present study an attempt was made to collect and analyze the information available in the patented documents of disease resistance genes in tobacco using mapping tools.

2. Materials and Methods

2.1 Collection of Patent Information

The patent information on disease resistance genes in tobacco, available in public domain, was collected from different online web resources (Table 1). The web resources were initially explored for their output pattern and the type and number of relevant records retrieved based on the search terms. In order to retrieve the information from various web resources, the following strings were employed.

- title:tobacco && (title:(disease resistance gene) || abstract:(disease resistance gene) || claims:(disease resistance gene)).
- (title:tobacco || abstract:tobacco || claims:tobacco) && (title:(defense gene) || abstract:(defense gene) || claims:(defense gene)).
- title:(tobacco or nicotiana) || abstract:(tobacco defense gene).
- title:nicotiana && abstract:(defense gene).
- abstract:tobacco && (title:(tobacco disease resistance gene) || abstract:(tobacco disease resistance gene) || claims:(tobacco disease resistance gene)).
- title:tobacco && abstract:(defense gene).
- (title:(resistant gene) || abstract:(resistant gene) || claims:(resistant gene)) && abstract:tobacco.
- title:tobacco && (title:(nucleotide sequence for disease resistance) || abstract:(nucleotide sequence for disease resistance) || claims:(nucleotide sequence for disease resistance)).
- title:tobacco && (title:(disease resistance genes or nucleotide sequence) || abstract:(disease resistance genes or nucleotide sequence) || claims:(disease resistance genes or nucleotide sequence)).
- title:tobacco && claims:(disease resistance gene).

- title:tobacco && abstract:(disease resistance gene).
- title:tobacco && abstract:(defense response gene).
- title:tobacco && (title:(pathogen gene) || abstract:(pathogen gene) || claims:(pathogen gene)).
- title:nicotiana && (title:(pathogen gene) || abstract:(pathogen gene) || claims:(pathogen gene)).
- title:tobacco && (title:(nucleotide sequence pathogen) || abstract:(nucleotide sequence pathogen) || claims:(nucleotide sequence pathogen)).
- title:tobacco && (title:(pathogen genes) || abstract:(pathogen genes) || claims:(pathogen genes)).

Table 1: Online web resources used for collecting patent information on disease resistance genes of tobacco

S. No.	Web resources used
1	http://www.lens.org ;
2	http://www.maxval.com
3	http://info.thomsoninnovation.com
4	https://www.pattools.com
5	https://www.acclaimip.com
6	https://www.patentinsightpro.com
7	http://thomsonreuters.com
8	http://www.matheo-patent.com
9	http://www.i2inc.com
10	http://www.dialog.com
11	http://www.micropatent.com

2.2 Mapping of Patent Information

The output records resulted using these strings, from 94 countries (Fig 1), were manually curated for their relevance and sorted out stringently in to a separate file comprising of patent applications and granted patents. The curated records were analyzed through the online tools available under patent lens software (<http://www.lens.org>) for mapping based on different aspects like documents, jurisdictions, applicants, top cited, owners, inventors, year wise publication of patents etc.

3. Results and Discussion

In order to develop disease resistance crop varieties, as a part of biotic stress management, scientists investigated large number of genes, promoter and other regulatory elements in various crops. The information on many of those valuable genes is either



Fig 1: Countries with codes and number of patent documents retrieved through online database search



Fig 2: Document map indicating the various types of patent documents retrieved through online database search

protected in the form of patent or published and available in public domain. Patent information forms a very useful resource of technical knowledge for researchers, engineers and scientists who are involved in research and technology development work.

However, patent documents are often lengthy, more so, in technologies related to life sciences,

pharmaceuticals and biotechnology. Often, it becomes necessary to look page by page, at copies of the original patent specification and mine data available as meaningful information. This is very laborious and time-consuming. In earlier days, accessibility to patent collections was difficult as one had to visit one of a small number of specialized patent collections. With

the increasing availability of online sources for patent information, this data is now becoming more accessible and often free of cost. It has always been an obligation on the patent holder to make the details of the invention available to the public in a form that enables a skilled person to carry out the invention. In the past, due to the cost and difficulty of access to information its benefits were not widely shared. Recent advances in information technology now mean that this legal requirement is increasingly a practical reality around the world. Much valuable patent information is now available free of charge for anyone with an internet connection.

In general, no database has complete coverage of all patent documents ever published worldwide. Hence, it may be necessary to consult multiple databases in order to find and then access patent documents of relevance. Hence, in order to retrieve the specific patent information about disease resistance genes in tobacco, different online patent databases were searched using appropriate search terms and strings. A total of 8542 records were retrieved for disease resistance genes in tobacco from different databases. These records after manual curation according to their relevance were reduced to 124 comprising of patent applications and granted patents. The sorted records were mapped based on different aspects like jurisdictions, inventors etc. using online tools available under patent lens software (<http://www.lens.org>). Based on the document types, the records were mapped into 92 patent applications, 29 granted patents, one limited patent and a search report (Fig 2). Majority of the cases, the subject matter of patenting includes methodologies, isolation of defense related genes, vectors etc.

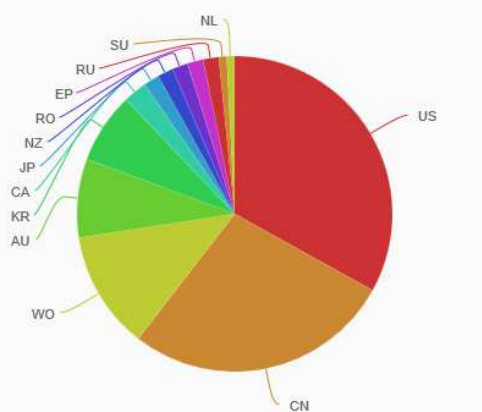


Fig 3: Jurisdiction map with number of patent records retrieved from different countries

3.1 Jurisdiction Wise Patenting

Jurisdiction analysis (Fig 3) revealed that majority of the patent records were filed from USA (41), followed by China (34), WIPO (15), Australia (10), South Korea (9) and Canada (3). While, Japan, New Zealand, Romania, and European Patent Office obtained two patents each and Soviet Union and Netherlands one each.

3.2 Patenting Based on Applicants and Inventors

The inventor need not be a applicant of a patent and vice versa, hence, the patent records were analyzed independently for these features. Based on the applicant analysis (Fig 4) it is evident that US Smokeless Tobacco Co, University of Fujian Agriculture and Forestry and 'Syngenta Participations Ag' are active in disease resistance gene patenting in tobacco with 19, 11 and 11 patents, respectively. Other active applicants are University of Kentucky Research Foundation and University of California (six applications); Xu Dongmei and US Agriculture department (five) and three each from Gavilano Lily, Siminszky Balazs and Bowen Steven W.

Further, inventor analysis of patents revealed that Xu Dongmei and Nielsen Mark from US Smokeless Tobacco company, USA obtained highest number, 21 and 14 patents, respectively (Fig 5) followed by Shunhui Chen from Institute of Fujian Tobacco Agricultural Sciences, Fuzhou, Fujian, China; Weijian Zhuang, Hua Chen and Tiecheng Cai with six patents each in the said area.

3.3 Top Cited Patents

Patent citation analysis carried out among the listed patent records in the core area of research in disease resistance genes in tobacco indicated that the patent number WO 03/00906 A2 has highest citations of 125 compare to others (Fig 6). This invention was relates to the field of plant molecular biology, more specifically to the regulation of gene expression in plants in response to pathogen exposure, and even more particularly to genes and polypeptides related to disease resistance. In view of the wide applicability of the invention revealed in this patent document with respect to disease resistance, it acted as a base for many other patents.

3.4 Owners Wise Patenting

The patent records were analyzed for categorizing the owners with more patents. It helps in finding the prospective firms and aide in building business associations in the said area. It is apparent from the analysis, U S. Smokeless Tobacco Company

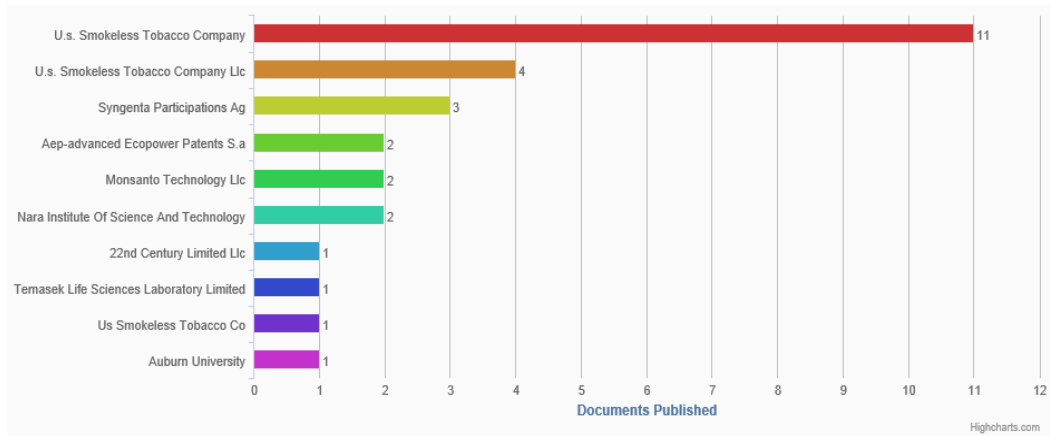


Fig.4. Applicants of patents on disease resistance genes in tobacco

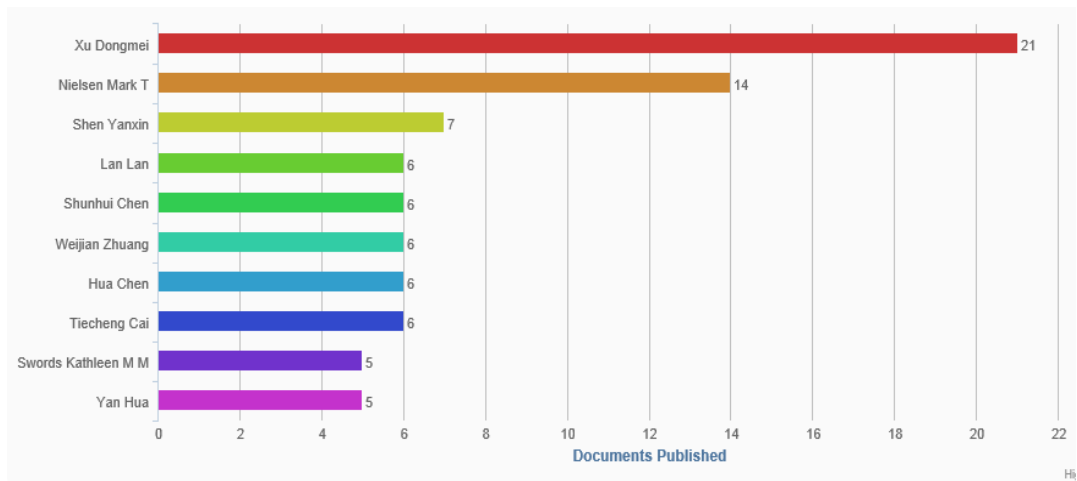


Fig 5: Inventors of patents on disease resistance genes in tobacco

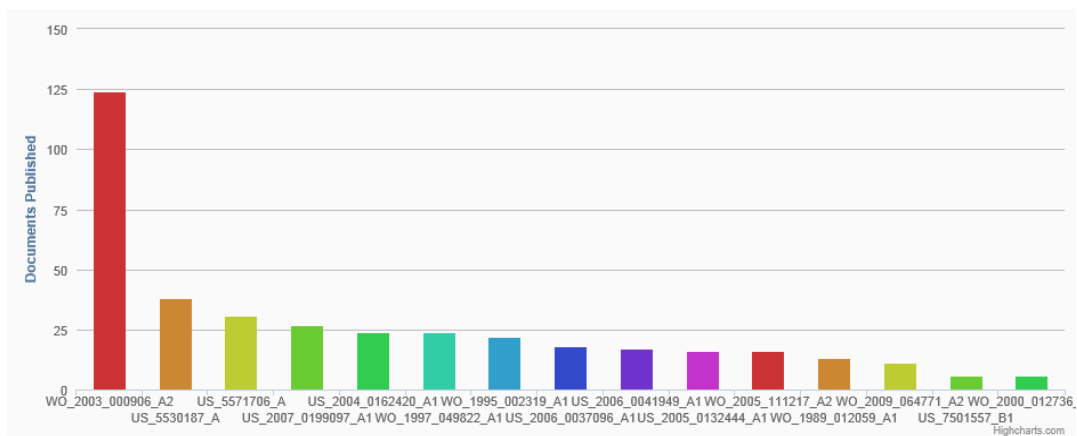


Fig 6: Top cited patents in the area of disease resistance genes in tobacco

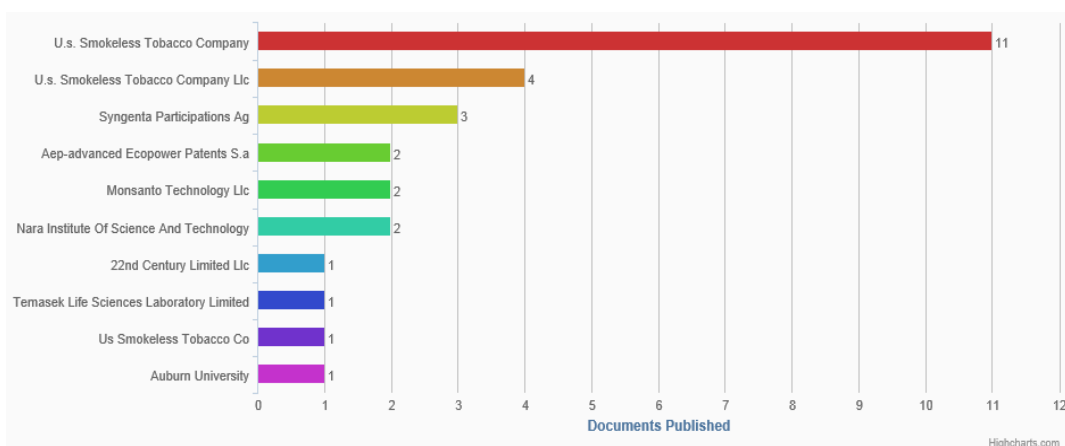


Fig 7: Owners of patents from US in the area of disease resistance genes in tobacco

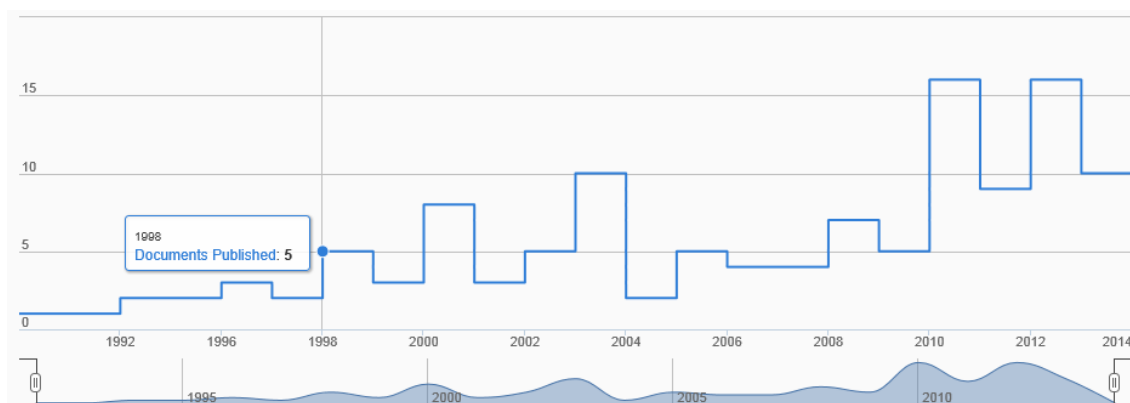


Fig 8: Year wise publication of patents in the area of disease resistance genes in tobacco

has 11 patents with ownership among the 29 granted patents (Fig 7).

3.5 Year Wise Publication of Patents

The patent records were further analyzed based on the year of publication in order to find out the annual progress in the disease resistance gene in tobacco. It is evident from the analysis the patenting in disease resistance genes especially in tobacco is initiated in 1992 and there is considerable progress in patenting from the year 2000 onwards (Fig 8). This progress was further hastened from year 2010 onwards with more number of published patent documents per year.

4. Conclusion

Patenting in disease resistance genes especially in tobacco is initiated in 1992 and there is considerable progress in patenting from the year 2000 and it was more prominent from 2010 onwards. There are a total of 124 patent documents were found in this area. Majority of these patent documents (more than 60%) are in the jurisdiction of USA and China. US Smokeless Tobacco Company and Syngenta Participations are the two private firms holding majority of the patents. In public sector, University of Kentucky Research Foundation and University of California have more patents than other public sector institutes. Dr. Xu Dongmei and Dr. Nielsen currently working with US Smokeless Tobacco Company have active profile in patenting of disease resistance genes in tobacco.

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