

**SIXTH FRAMEWORK PROGRAMME**  
**THEMATIC PRIORITY 5**  
**FOOD QUALITY AND SAFETY**



ResistVir

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Co-ordination of Research on genetic resistance to plant Pathogenic Virus, and their  
Vectors in European Crops

Project number: FOOD-CT-2005-006961

Co-ordination Action

***Report on the construction of a database  
of patent on plant viruses***

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# Introduction to the ResistVir plant virus resistance patent database

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The patents are presented alphabetically by the "Group (gene or mechanism)" into which we have arbitrarily divided all the patents. The Patent Database Tables are explained below (see Table 1). All the hyperlinks to the patent full texts should work, but some seem to be "stiff", and need repeated "clicking", sometimes with an intermediate "click" on an adjacent cell.

The database is divided into 3 sections:

1. The main database.

2. Plant virus resistance "claimed".

3. Plant Variety Patents.

1. The main database consists of a list of 159 different patent "groups" (interconnected patents from related applications or different jurisdictions, mostly corresponding to patent "families"), each demonstrating plant virus resistance. Some plant cultivars are now covered by patents rather than by the Plant Variety Patents.

2. Plant virus resistance is claimed but not demonstrated in 97 groups of patents i.e. the authors claim that their method can also produce plant virus resistance, but have not shown an example. This consists of a diverse range of mechanisms. Many demonstrate resistance to some plant pathogen, and by extension claim resistance to a list of other pathogens, including viruses. Some claim plant cultivars (not virus resistant) that will still be patented if transformed with e.g. virus resistance ("single gene conversion"). Others demonstrate resistance to a human or animal virus and by extension claim resistance to similarly created transgenic plants. A group of patents relate to plant viral genes cloned and sequenced, and claim their use in the production of transgenic resistant plants created with their help.

3. There are 48 Plant Variety Patents. This is a specialized type of patent on a defined plant cultivar. All but one of these patent claims virus resistance in *Lilium* spp without showing any resistance data, or discussing any particular virus species.

The differentiation between sections 1 and 2 is a scientific decision (i.e. whether data is shown on plant virus resistance), and is not related to patent issues.

**Table 1.** The column headings of each section of the database.

<b>Column heading in Database</b>	<b>Meaning</b>
Group (gene or mechanism)	General grouping of the patents according to the resistance technology developed.
Plant virus resistance tested	The virus(es) that were tested in that patent, NOT what was claimed
Host tested	The host plant inoculated by above viruses, NOT what was claimed
Title	Full title of the patent
Publication Number	Publication number of the patent
Publication Date	Publication date of the patent
Assignee/ Applicant Name	The owner of the patent
Inventor Name	The inventor of the patent
Abstract	A summary of the patent in English – sometimes taken from an equivalent publication
Priority Number	Number assigned pre-publication; may be different from publication number
Priority Date	Original application date; different from publication date
Link to full text	Hyperlink giving free direct access to full patent text
See also	Closely related patents (other versions, in other jurisdictions). Note that there may be different claims in different jurisdictions

## Commonly used abbreviations in ResistVir Patent database

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CP: coat protein  
HR: hypersensitive response  
MAPK: mitogen-activated protein kinase  
MP: movement protein  
NIb: nuclear inclusion protein b  
PTGS: Post transcriptional gene silencing  
Rep: viral replicase  
SAR: systemic acquired resistance

## Virus abbreviations in ResistVir Patent Database

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*Alphabetically by full virus name*

*Not yet checked against the list of ICTV-approved acronyms*

AMV: alfalfa mosaic virus  
BaMMV: barley mild mosaic virus  
BYDV: barley yellow dwarf virus  
BaYMV: barley yellow mosaic virus  
BCMV: bean common mosaic virus  
BGMV: bean golden mosaic virus  
BNYVV: beet necrotic yellow vein virus  
BPYV: beet pseudo-yellows virus  
BYMV: bean yellow mosaic virus  
BWYV: beet western yellows virus  
BMV: brome mosaic virus  
CaMV: cauliflower mosaic virus  
CsCMV: cassava common mosaic virus  
CCMV: cowpea chlorotic mottle bromovirus  
CEVd: citrus exocortis viroid  
CTV: citrus tristeza virus  
CYVV: clover yellow vein virus  
CFMMV: cucumber fruit mottle mosaic tobamovirus  
CGMMV: cucumber green mottle mosaic tobamovirus  
CMV: cucumber mosaic virus  
CYSDV: cucurbit yellow stunting disorder virus  
GLRaV: grapevine leafroll virus  
GFLV: grapevine fanleaf virus  
GRSV: groundnut ringspot virus  
HpLV: hop latent virus

INSV: impatiens necrotic spot virus  
LIYV: lettuce infectious yellows virus  
LMV: lettuce mosaic virus  
MCDV: maize chlorotic dwarf virus  
MDMV: maize dwarf mosaic virus  
PLDMV: papaya leaf-distortion mosaic virus  
PSRV: papaya ringspot virus  
PEBV: pea early browning virus  
PHV: pepper huasteco virus  
PMMoV: pepper mild mottle virus  
PepMoV: pepper mottle virus  
PVBV: pepper vein banding virus  
PMWaV: pineapple mealybug wilt virus  
PLRV: potato leaf roll virus  
PMTV: potato mop top virus  
PSTVd: potato spindle tuber viroid  
PVS: potato virus S  
PVX: potato virus X  
PVY: potato virus Y  
RBDV: raspberry bushy dwarf virus  
RYMV: rice yellow mottle virus  
RSPaV: Rupestris stem pitting associated virus  
SMV: soybean mosaic virus  
SqMV: squash mosaic virus  
SCSV: subterranean-clover stunt virus  
TEV: tobacco etch virus  
TMV: tobacco mosaic virus  
TNV: tobacco necrosis virus  
TRV: tobacco rattle virus  
TRSV: tobacco ringspot nepovirus  
TYDV: tobacco yellow dwarf mastrevirus  
TAV: tomato aspermy virus  
TBRV: tomato black ring virus  
TCSV: tomato chlorotic spot virus  
TGMV: tomato golden mosaic virus  
TLCV: tomato leaf curl virus  
ToMV: tomato mosaic virus  
ToMoV: tomato mottle geminivirus  
TPCTV: tomato pseudo-curly top virus  
TomRSV: tomato ringspot virus  
TSWV: tomato spotted wilt virus  
TYLCV: tomato yellow leaf curl virus  
TCV: turnip crinkle virus  
WMV: watermelon mosaic virus  
WCMV: white clover mosaic virus  
ZYMV: zucchini yellow mosaic virus

## **Differentiate between Patent and Patent Application**

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Note that a Patent is an award that has been granted, and therefore has a legal status. A Patent Application has not yet been granted. The status of an Application is not defined under our search conditions i.e. we are not supplied with information on the position of an Application in the long patenting process, or even if the Application has been abandoned. Additionally, we cannot know what will remain of the Claims of an Application after the Patent is granted. Many items in the database are Applications in a variety of jurisdictions (countries) with different legal requirements and processes. Further information on the status of Applications can be uncovered, but not within the scope of this project.

Note the following points concerning patents referenced in the ResistVir database:

1. US patents currently have numbers in the 5 to 7 million range.
2. From 1997 US patent Applications were published in the form of USyearxxxxxxx i.e. US2004000542902P.
3. Generally, US patents are granted for 17 years from issue (prior to 1997), and after 1997 from 20 years from filing application, which was already the case in most jurisdictions, including EPO.
4. European Patent Organization EPO: those Patents ending in A are applications (i.e. EP622461A3), while those ending in B i.e. EP517833B1, are patents.
5. World Intellectual Property Organization (WIPO) Patent Applications are prefaced WO – are all applications i.e. WO9707217A1.

## Useful web sites for patents

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Please note that searches for key words in these sites may not be very effective. However, searches by patent number, for instance in the US Patent Office (USPTO) site, usually obtain the required document.

<http://www.uspto.gov/patft/index.html>

[http://ep.espacenet.com/numberSearch?locale=en\\_ep](http://ep.espacenet.com/numberSearch?locale=en_ep)

<http://www.patentstorm.us>

<http://www.patentlens.net/daisy/patentlens/patentlens.html>

<http://www.google.com/patents>

<http://www.wipo.int/patentscope/en>

## Patent Search Strategy in this project

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For the patent search an Israeli patent search company (Arad-Ophir Ltd. <http://www.arad-ophir.co.il/>) was selected and tested. Results were delivered and kept in Excel format, which is ideal for a small database, as it is easily downloadable by all without special software.

### Initial considerations

A variety of search word combinations were tested reiteratively with the search company (searching in STN *Scientific and Technical information Network*). Many seemingly useful search term combinations resulted in significant losses of useful patents. Finally we realized that we had to use the broadest possible combination of search terms.

### Search in claims

We decided to search in the CLAIMS section of the patents, as this is actually the most important content of the patent. However, these are CLAIMS, not what was actually done i.e. not necessarily scientific content.

The search was interactive for about a month until May 22<sup>nd</sup>, 2006. It was carried out in the claims of the patents of the following Patent Authorities through the Delphion commercial service:

1. US – Granted patents from 1971 to search date.
2. US – Applications from 2001 to search date.
3. EP – Granted patents from 1991 to search date.

4. EP – Applications from 1986 to search date.
5. PCT – Granted patents and Applications from 1978 to search date.
6. Japan Abstracts from 1973 to search date.

The strategy was built together with the staff in the ARO Volcani Institute. Several search options were examined according to the following options. The results were read and evaluated a few times until a final strategy was chosen.

Strategies and Options evaluated:

1. Search for: *plant virus\* and resist\**

Problem: “*plant virus*” does not always appear as a concept. Using it as a concept causes the loss of many relevant patents mentioning *plants* separately from the word *virus*

2. Search for: *plant and virus\* and (resist\* or transgenic or transform\*)*

Problems arose as follows:

- a. Yield of thousands of patents
- b. Many duplicates from different jurisdictions, earlier applications or divisional applications.
- c. Some of the patents mention the subject somewhere in the description and do not claim anything focused
- d. Some patents mentioning “*transgenic*” would contain claims for a part of the virus – promoter or enhancer which have no relation to resistance.
- e. Many patents mention resistance: to kanamycin, NPTII gene, herbicide, or some disease resistance.
- f. The use of the word “*transformation*”, even in claims only, added about 700 patents, highly irrelevant.
- g. Some are concerned other aspects of plant virology e.g. virus vectors, suppressors of silencing, strong viral promoters (Cauliflower Mosaic Virus 35S Promoter), viral genes or viral replicons.

3. Finally the search was limited to Claims only.

4. Search of the words “*virus\**” at a distance of 5 words from the word “*resist\**”. That caused a substantial loss of relevant patents.

5. After a few trials to refine the search by different strategies, the conclusion was that there is no ideal way of doing it, and yet not losing important information. The final strategy (on 22.6.2006) was widely defined although limited to the claims only, yielded 1257 patents and refined manually by reading; therefore *Plant and Virus\* and Resist\** was searched in the Claims of the patents in the above list of Patent Authorities.

#### Problems with searching patent claims

Many demonstrate resistance to some plant pathogen, and by extension **claim** resistance to a list of other pathogens, including viruses.

Some **claim** plant cultivars (not virus resistant) that will still be patented if transformed with e.g. virus resistance.

Some **claim** some resistance to a human or animal virus and by extension to similarly created transgenic plants.

Results are **claimed**, not necessarily mechanisms (scientifically disappointing).

#### Preliminary results reported at ResistVir Helsinki meeting July 2006

In the first search 1287 patents located by the company.

Reduced to 497 after first manual screen – including 48 Plant Variety Patents.

After second screening by us, including intensive exclusion of duplicates, reached 290 patent “groups” *plus* 48 PVPs.

#### Final position (January 2009)

1. 159 different patent groups demonstrating plant virus resistance.
2. 97 groups of patents where plant virus resistance is claimed but not demonstrated
3. 48 Plant Variety Patents