



Joseph Marie Bové

Né le 5 mai 1929 à Luxembourg (Grand Duché)

Nationalité française, depuis 1968

Epouse : Colette Bové Dumeau (1927-2014)

Trois enfants, cinq petits-enfants, trois arrière petits-enfants

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Education

- Education secondaire: Bordeaux, Lycée Michel Montaigne
- Education supérieure: Institut National Agronomique (Paris) et Université de Paris, Sorbonne (1950-1955)

Formation à la recherche

- Université de Californie à Berkeley
 - ◆ avec D.I. Arnon (1956-1958) : recherches sur la phosphorylation photosynthétique
 - ◆ avec P.K. Stumpf (1958-1959) : recherches sur l'enzyme de condensation
 - ◆ avec W.M. Stanley et R. Steere (1959) : recherches en virologie
- Thèse de doctorat es sciences sous la direction de George Morel (INRA, Versailles) et de Jacques Monod (Institut Pasteur, Paris) sur l'ARN réplicase du virus de la mosaïque jaune du navet et la synthèse *in vitro* d'ARN viral (1967)

Fonctions

1959-1968	Chef du service de Biochimie de l'IRFA (Institut de recherches sur les fruits et agrumes)
1968-1971	Professeur associé, Université de Nancy, France
1971	Nommé sur concours Directeur de recherche INRA Nommé Directeur de la Station de Physiologie végétale, INRA, Bordeaux
1974	Nommé Directeur du Laboratoire de Biologie cellulaire et moléculaire
1976	Nommé Professeur de Microbiologie, Université de Bordeaux 2, pour enseigner la biologie moléculaire des procaryotes et de leurs virus et la biologie moléculaire des virus des eucaryotes.
1995	Nommé Professeur en surnombre, Université de Bordeaux 2
1998...	Nommé Professeur émérite, Université of Bordeaux 2

Activités de recherche

250 publications dans des revues internationales

9500 citations – $h = 48$ (ISI Web of Science, décembre 2015)

Sélection de publications

Simpson et al. 2000. The genome sequence of the plant pathogen *Xylella fastidiosa*. *Nature* **406**, 151-157

Bové JM. 2006. Huanglongbing: a destructive, newly emerging, century old disease of citrus. *Journal of Plant Pathology* **88**, 7-37

Saglio et al. 1973. Spiroplasma-citri-gen and sp-n-mycoplasma-like organism associated with stubborn disease of citrus. *International Journal of Systematic Bacteriology* **23**, 191-204

- Jagoueix et al. 1994. The phloem-limited bacterium of greening disease of citrus is a member of the alpha-subdivision of the proteobacteria. *International Journal of Systematic Bacteriology* **44**, 379-386
- Jagoueix et al. 1996. PCR detection of the two 'candidatus' liberobacter species associated with greening disease of citrus. *Molecular and Cellular Probes* **10**, 43-50
- Chang et al. 1993. Culture and serological detection of the xylem-limited bacterium causing citrus variegated chlorosis and its identification as a strain of *Xylella fastidiosa*. *Current Microbiology* **27**, 137-142
- Cole et al. 1973. Morphology, ultrastructure, and bacteriophage infection of helical mycoplasma-like organism (*Spiroplasma citri* gen-nov, sp-nov) cultured from stubborn disease of citrus. *Journal of Bacteriology* **115**, 367-386
- Bové JM. 2014. Huanglongbing or yellow shoot, a disease of Gondwanan origin: Will it destroy citrus worldwide? *Phytoparasitica* **42**, 579-583
- Wulff et al. 2014. The complete genome sequence of 'Candidatus Liberibacter americanus', associated with citrus Huanglongbing. *Molecular Plant-Microbe Interactions* **27**, 163-176
- Nelson et al. 2013. The pangaeian origin of "Candidatus liberibacter" species. *Journal of Plant Pathology* **95**, 455-461

Principaux sujets de recherche

- 1959 – 1986 réplication des virus des plantes
- 1969 – 2004 bactéries endogènes des plantes : 1/ localisées dans le phloème (*Spiroplasmas*, *Phytoplasmas*, *Liberibacters*, *Phlomobacters*) et 2/ localisées dans le xylème (*Xylella fastidiosa*)
- 1959 – 2012 maladies infectieuses des agrumes

Principaux résultats de recherche

- Découverte, identification, caractérisation, taxonomie et détection par PCR de *Candidatus Liberibacter africanus*, *Candidatus Liberibacter asiaticus*, et *Candidatus Liberibacter americanus*, les agents responsables du « huanglongbing » (ex-greening) en Asie, en Afrique et en Amérique, respectivement
- Découverte, identification, caractérisation, taxonomie, pathogénie, détermination de la séquence du génome et détection par PCR de *Spiroplasma citri*, le mollicute responsable du « stubborn » des agrumes
- Identification de *Circulifer haematoceps*, la cicadelle vecteur de *Spiroplasma citri* dans le Bassin Méditerranéen, le Proche Orient et le Moyen Orient
- Découverte, identification, caractérisation, taxonomie, et détection par PCR de *Candidatus Phytoplasma aurantifolia*, le phytoplasme responsable de la maladie des balais de sorcière de la lime au Sultanat d'Oman, les Emirats Arabes Unis, et l'Iran
- Identification de *Hishimonus physitis* en tant que cicadelle vecteur de *Candidatus Phytoplasma aurantifolia*
- Découverte et identification de *Xylella fastidiosa*, la bactérie du xylème responsable de la chlorose variéguée des agrumes au Brésil
- Identification de la "Mort Subite des Agrumes" en tant qu'une maladie de la ligne de greffe, transmissible par greffage et ayant de nombreuses analogies avec la Tristeza des agrumes. Développement de méthodes de lutte
- Création d'une collection de 37 souches de la bactérie du Huanglongbing à partir de 14 pays

Activités de recherche internationales sur les maladies des agrumes

- Pour la FAO : enquêtes et prospections sur les maladies des agrumes du Maroc au Pakistan (1981-1992)
- Identification de *Circulifer haematoceps* comme la cicadelle vecteur de *Spiroplasma citri* en Syrie (1979-1986)

- Etude de la maladie des balais de sorcière de la lime au Sultanat d'Oman (1986, 1987, 2003, 2004), les Emirats Arabes Unis (1992) et l'Iran (1997). Identification de l'insecte vecteur, la cicadelle *Hishimonus phytitis* (1991)
- Etude du Huanglongbing en Afrique du Sud (1967-1972, 1998, 2006, 2008, 2011) Madagascar (1967, 2011), île de la Réunion (1970-1995), Arabie Saoudite et Yémen (1981-1983), île Maurice (1992-1998), Inde (1990-1992), Bali (Indonésie) (1996-1998), Vietnam (1995, 2000, 2002) Chine (Beihai) (1999, 2005), Népal (1992, 1994, 2000, 2002, 2004, 2008) et Bhutan (2002, 2004, 2006, 2007), Brésil (2004...), Cuba (2008), Soudan (2008), République Dominicaine (2009), Mexique (2009, 2011), Belize (2009)
- Mise en place de laboratoires pour le diagnostic par détection PCR de *Candidatus Liberibacter asiaticus* en Indonésie (Malang, Java ; Bali) (1996-1998), Vietnam (Long Dinh) (2000-2002), Népal (Katmandu) (2002-2004) et Bhutan (Timphe) (2004-2006)
- Amélioration du laboratoire de diagnostic des virus et des bactéries endogènes des agrumes au Centre « Fundecitrus », Araraquara, São Paulo State, Brésil (1997-1999)
- Contribution au séquençage du génome de *Xylella fastidiosa*, la bactérie du xylème responsable de la Chlorose variéguée des agrumes, Brésil (1997-2000)
- Etude de la Mort Subite des Agrumes en collaboration avec Fundecitrus, Araraquara, São Paulo State, Brésil (2002-2011)
- Réhabilitation des agrumes au Népal par l'utilisation d'arbres greffés sur porte-greffes à la place d'arbres de semis (2004-2008)

Administration de la recherche

1974-1994	Directeur du Laboratoire de Biologie cellulaire et moléculaire, INRA et Université de Bordeaux 2
1984-1994	Président de l'INRA en Aquitaine
1993-1997	Président du Conseil scientifique de la Station de recherche (INRA/CIRAD) sur les agrumes, San Giuliano, Corse
1994-1999	Construction de l'Institut de biologie végétale moléculaire (IBVM) au centre INRA de Bordeaux
1999-2000	Premier directeur de l'IBVM

Responsabilités internationales

1969-1972	Président de l'Organisation Internationale des Virologistes des Agrumes (IOCV)
1992-1994	Président de l'Organisation Internationale pour la Mycoplasmologie (IOM)
1981-1992	Expert à la "Food and Agriculture Organization" (FAO) pour prospecter les maladies infectieuses des agrumes au Proche Orient et au Moyen Orient. Les résultats de ces enquêtes ont été publiés par la FAO sous forme d'un ouvrage illustré par de nombreuses photos en couleur des symptômes des maladies

Appartenance à des académies scientifiques

1992	Elu membre de l'Académie d'agriculture de France
1993	Elu membre correspondant de l'Académie des sciences, Paris
1994	Nommé « fellow » de la Société de phytopathologie américaine
1996	Elu « fellow » de l'Académie américaine de microbiologie
2002	Membre de l'Académie Brésilienne des sciences
2004	Nommé « fellow » de l'Organisation Internationale des virologistes des agrumes (IOCV)

Prix

1971	Médaille d'argent du CNRS pour la culture du premier mycoplasme d'origine végétale
1973	Prix "René Dujarric" de l'Académie des sciences
1982	Citation pour services rendus à l'Organisation internationale de mycoplasmologie (IOM)
1983	Prix "Dufrenoy" de l'Académie d'agriculture de France

- 1984 Prix "Klieneberger-Nobel" de l'IOM
- 1992 Prix "J. Merrill and Adeline Wallace" pour la meilleure communication présentée à la onzième conférence de l'Organisation internationale des virologistes des agrumes (IOCV) : Etude de l'organisme du « greening » au moyen d'anticorps monoclonaux
- 1995 Prix "J. Merrill and Adeline Wallace" pour la meilleure communication présentée à la douzième conférence de l'IOCV : Identification de la bactérie *Xylella fastidiosa* en tant qu'agent causal de la chlorose variéguée des agrumes
- 2004 Nommé « Fellow » de l'IOCV

Organisation de manifestations internationales

- 1966 Visites post-congrès en France, Espagne et Maroc à l'issue du 4^{ème} congrès de l'IOCV, Italie, octobre 1966
- 1972 6^{ème} congrès de l'IOCV au Swaziland avec visites pré-congrès en Afrique du Sud et post-congrès à Madagascar, l'île de la Réunion et l'île Maurice, août 1972
- 1974 Premier Congrès international de mycoplasmodologie: « Mycoplasmes de l'Homme, des Animaux, des Plantes et des Insectes » Bordeaux, septembre 1974
- 1975 - Symposium International sur les virus des plantes, Bordeaux, septembre 1975.
- 7^{ème} congrès of de l'IOCV en Grèce avec visites pré-congrès en Israël et post-congrès en Egypte, octobre 1975
- 1977 Cours international sur les maladies à virus et à mycoplasmes des agrumes, des arbres fruitiers et de la vigne, Bordeaux, février à juin 1977
- 1979, 1983 et 1987:
Trois cours internationaux sur les techniques de mycoplasmodologie, Bordeaux, 3-21 septembre 1979, 20 juin-7 juillet 1983 et 21 juin -8 juillet 1987
- 1991 Symposium sur les Biotechnologies dans le Sud Europe Atlantique, Bordeaux, 23-25 octobre 1991
- 1992 12^{ème} congrès de l'IOCV, New Delhi, 22-29 novembre, avec visites pré-congrès au Sultanat d'Oman pour observer la maladie des balais de sorcière de la lime due à *Candidatus Phytoplasma aurantifolia*
- 1993 Symposium sur les Biotechnologies dans le Sud Europe Atlantique, Porto, janvier 1993
- 1994 10^{ème} congrès de l'Organisation internationale pour la mycoplasmodologie, Bordeaux, 19-26 juillet 1994
- 1995 Symposium sur les Biotechnologies dans le Sud Europe Atlantique, Bilbao, mai 1995
- 1996 Second symposium sur la Biologie moléculaire des plantes entre la France et la Thaïlande, Bordeaux, 6-10 octobre
- 1999 Symposium Franco-Chinois sur les maladies à virus et à bactéries endogènes des agrumes, Kunming, juillet 1999

Distinctions

- 1972 Mérite Agricole, Chevalier
- 1993 Palmes Académiques, Officier

Biographical statement

Joseph Marie Bové was born in Luxemburg in 1929 and acquired the French nationality in 1968. He and his wife Colette are the happy parents of three boys: José, Hugues and Henri. J.M. Bové is emeritus professor of microbiology, University of Bordeaux, France, and honorary director of research at INRA, the French "National Institute for Agricultural Research". He graduated from the School of Agronomy and the University of Paris in 1953. For his doctorate in sciences, he worked at the INRA research center in Versailles on the replication of plant viruses under the leadership of Georges Morel (1916-1973), best known for having cultured meristems to obtain virus-free plants. Bové was one of the first to purify, from infected plants, the enzyme "replicase" that carries out the synthesis of viral RNA. From 1956 to 1959, he and his wife spent three years at the University of California at Berkeley,

first in the laboratory of Prof. D.I. Arnon, where they participated in the elucidation of the role of chloride in photosynthesis, and next in the laboratories of Prof. P. K. Stumpf and E. E. Conn, gaining experience in enzyme mechanisms.

From 1959 on, in the frame of the "French Institute for Citrus and Tropical Fruit Research", with his laboratory at INRA-Versailles, J.M. Bové took an active part in the development of the citrus experiment station at San Giuliano in Corsica, France. He and Robert Vogel (1929-2002), his friend and colleague at the Station, introduced indexing procedures for virus and virus-like diseases of citrus, discovered a new graft-transmissible disease, cristicortis, widespread in the Mediterranean basin, used shoot-tip grafting to supply nurseries with healthy budwood, which eventually resulted in a budwood certification program.

In 1971, Dr. Bové moved from Versailles to Bordeaux to become head of the laboratory for cellular and molecular biology at the INRA/University of Bordeaux campus, where he and his wife have carried out most of their research on the etiology of citrus diseases. In the frame of an international collaboration, he and his group showed, in the early 1970s, that stubborn disease, prevalent in the Near East and the Middle East, as well as in California and Arizona, was not of viral nature, but was due to a new type of plant bacteria, discovered in Japan in 1967: the wall-less mycoplasmas. They named the stubborn agent *Spiroplasma citri* because of the unexpected helical morphology of a wall-less bacterium. The stubborn agent has been the subject of many molecular and cellular studies not only during Prof. Bové's years of activity, but also after his retirement when his coworkers took over: J. Renaudin, C. Saillard, P. Carles, X. Foissac, to cite only a few. These studies have culminated in unraveling the mechanisms of *S. citri* pathogenicity and insect-vector transmission, and in determining the complete sequence of the spiroplasmal genome (2005).

In 1970, Dr. Bové and his coworker, Dominique Lafèche, also discovered the bacterial agent of huanglongbing (HLB), which was still called greening in these early days. Both the stubborn agent and the greening agent were restricted to the sieve tubes in the phloem tissue, but while the stubborn spiroplasma was a bacterium lacking a cell wall, i.e. a mycoplasma, the greening agent was soon found to be a bacterium with a well-defined cell wall of the Gram negative type. Soon after its discovery in 1970, the stubborn agent could be cultured not only in Bordeaux but also in Riverside at the University of California in the laboratory of E. C. Calavan (1913-1998), and this opened the way to the many studies that followed (see above). On the contrary, the greening agent has never been obtained in permanent cultures, not even today, and only in the 1990s, when molecular, DNA-based techniques became available, could the agent be characterized taxonomically and found to be a new genus within the Gram negative bacteria, *Candidatus Liberibacter*, with two species: *Candidatus Liberibacter africanus* for greening in Africa, and *Candidatus Liberibacter asiaticus* for the disease in Asia. The word "*Candidatus*" indicates that the organism is not yet cultured. Dr. Bové's student, coworker and friend, Monique Garnier (1949-2003), and her own students and coworkers, including S. Jagoueix-Eveillard, took a great part in the studies on greening and, in particular, the detection, first by electron microscopy and later by PCR, of the HLB-bacterium from many countries in Africa and Asia, including Bhutan, Cambodia, India, Indonesia, Laos, Malaysia, Mauritius, Nepal, Reunion island (France), Saudi Arabia, South Africa, Vietnam, Yemen and Zimbabwe. HLB-detection laboratories were set up in Kathmandu (Nepal), Batu (Eastern Java, Indonesia) and Thimphu (Bhutan).

From 1981 to 1993, as consultant of the Food and Agriculture Organization (FAO), Prof. Bové surveyed many countries in the Near East, the Middle East and Western Asia, for diseases of citrus. This is how, he and his coworkers discovered (i) the leafhopper-vector of stubborn disease in Morocco, Turkey and Syria: *Circulifer haematoceps*, (ii) HLB in Saudi Arabia, Yemen and Somalia, and (iii) a new disease of citrus in Oman: witches broom disease of lime trees (WBDL), caused by a non-cultured mycoplasma, *Candidatus Phytoplasma aurantifolia*, and insect-vectored by the leafhopper, *Hishimonus phycitis*, as confirmed in Iran by M. Salehi et al. in 2007. WBDL is also severely affecting the United Arab Emirates and Iran.

From 1989 to 1993, Prof. Bové and his group, in collaboration with Victoria Rossetti (Instituto Biológico, São Paulo) and C.G. Chang (University of Georgia), showed by electron microscopy and serology that Citrus Variegated chlorosis (CVC), which affected more than 50% of all sweet orange trees in SPS, was caused by the well-known plant bacterium, *Xylella fastidiosa*, the xylem-restricted agent of a most severe disease of grapevine, Pierce's disease.

Since 1998, when he retired, Prof. Bové has actively collaborated with Fundecitrus, the foundation for the sanitary control of citrus in São Paulo State, Brazil, on various citrus diseases including Citrus Sudden Death (CSD) and, for the last ten years, HLB.

CSD, a disease never seen before, kills trees grafted on Rangpur lime. In collaboration with Fundecitrus and the Citrus Research Center at Moncada (Valencia) in Spain, it could be shown that the pathological anatomy of CSD at the bud union region was very similar to that of tristeza - quick decline. In addition to citrus tristeza virus (CTV), endemic in SPS, CSD was found by Allelyx Applied Genomics (Campinas, SPS, Brazil) to be associated with a second virus, a marafivirus (Tymoviridae). Thus, all symptomatic sweet orange trees carry both CTV and the marafivirus, but symptomless trees on tolerant rootstocks, (Cleopatra mandarin, Sunki mandarin, Swingle citrumelo) also carry the two viruses. The respective roles of the two viruses is not yet understood. It could be confirmed recently that CSD is transmissible by graft inoculation and by aerial vectors, most probably aphids. The disease was finally controlled by inarching, i.e. approach-grafting seedlings of tolerant rootstocks to the scion trunk of affected trees on Rangpur lime. Agronomists of the SPS Citrus Industry, and in particular Luiz F. Giroto, greatly contributed to this novel control procedure.

In March 2004, the HLB was identified for the first time in America, namely in São Paulo State. A new liberibacter species was discovered, *Candidatus Liberibacter americanus*, and was present in most of the trees, but *Ca. L. asiaticus* also infected a small number of trees. By 2014, the situation has entirely reversed, as *Ca. L. asiaticus* (Las) is now present in most of the newly infected trees, while *Ca. L. americanus* (Lam) is difficult to find, probably because, as shown by Fundecitrus, the titer of Lam in the trees is ten times lower than that of Las and therefore Lam is less actively transmitted by the psyllid vector. Reliable PCR techniques have been developed for confirmation of HLB symptoms. Control of HLB has started almost immediately after identification of the disease, and is based on a three-pronged system: (i) removal of all symptomatic trees, (ii) their replacement with healthy trees produced in covered, insect-proof nurseries and (iii) insecticide control of psyllid populations. Farms in which rigorous HLB management has been practiced from 2004 to 2014 have an HLB incidence as low as 1% symptomatic trees a year (or, in other words, close to 99% healthy trees!) and (ii) they account for a surface area of 200,000 ha, i.e., almost half of the total citrus acreage in São Paulo State. In Florida, where HLB was reported in 2005, most citrus growers were reluctant to remove symptomatic trees and HLB control has largely failed.

Prof. Bové is a member of the French Academy of Agriculture, a corresponding member of the French Academy of Sciences, a member of the Brazilian Academy of Sciences, a fellow of the American Academy of Microbiology, a fellow of the American Phytopathological Society, and a fellow of the International Organization of Citrus virologists (IOCV). He has been chairman of the IOCV from 1969 to 1972 and of the International Organization for Mycoplasmaology from 1992 to 1994. He was President of INRA in southwestern France from 1984 to 1994.