

> Rose selection in France: a long and beautiful history

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Introduction

A multitude of species provide ornamental plants for the embellishment of public spaces, gardens, balconies and homes and for the production of cut flowers. The genus *Rosa*, due to its popularity, history, and incredible diversity of traits (from flower shape, colour, scent, to architecture) is considered as the “queen of the flowers.” Its diversity of usage (cut flower, miniature indoor pot plant, garden shrub, climbing plant, but also perfume and some culinary tradition) can explain its high economic value which has earned it the title of the world’s favourite flower.

The genus *Rosa*, comprised of 150-200 species (Wissemann and Ritz, 2007) well distributed circumpolar boreal, presents a complex evolutionary history. At least 30,000 cultivars have been listed (Roberts et al., 2003), and many of them have a French origin (Figure 1). In France, the rose industry involves many actors, including private (breeders, producers) and public (research teams and horticultural technical institutes) entities.

The rose in France

Indigenous French species

Slightly less than 20 wild *Rosa* species are endemic in France, with the addition of the highly complex *Rosa canina* aggregate in which taxon delimitation is particularly complex. These species belong to subgenus *Rosa*, and are grouped predominantly in section *Caninae*, though some are members of sections *Rosa* or *Gallicanae*. A few ornamental taxa have escaped from cultivation, particularly *Rosa banksiae* W.T.Aiton and *Rosa rugosa* Thunb., and the most characteristic species is *Rosa gallica* L., protected at the national level but also source of numerous cultivars and old cultivated hybrids.

Roses are probably more numerous in France as a result of human practices.

Consumption

Roses are by far the leading ornamental product in France. More than half of the money spent on cut flowers by the French is for roses (€376.3 million in 2018). It is the leading flower for Mother’s Day, Valentine’s Day, as well as for Christmas. The rose is also the



■ Figure 1. A) ‘Aimée Vibert’ (1824, Vibert), B) ‘Belvédère’ (1829, Jacques), C) ‘Safrano’ (1839, Beauregard), D) ‘Triomphe de l’Exposition’ (1855, Margottin), E) ‘La France’ (1867, Guillot), F) ‘Etoile Luisante’ (1918, Turbat), G) ‘Raymond Privat’ (1935, Privat), H) ‘Papa Meilland’ (MEIcesar, 1963, Meilland), I) ‘Paul Bocuse’ (MASpaujeu, 1997, Massad), J) ‘Red intuition’ (DELstrio, 1999, Delbard), K) ‘Brocéliande’ (ADATERhuit 2000, Adam), L) ‘Jardin de Grandville’ (EVanrat, 2010, André Eve) (Credit: 1A) Cristiana Oghina-Pavie, UA, 1B-L) Agnès Grapin, Institut Agro).

leading plant purchased for gardens, with a value of €50.2 million in 2018. This represents almost 5 million rosebushes bought by private individuals, to which must be added

roses for landscaping by local authorities (around 2 million). Miniature roses are in the top 3 of the indoor plants (2.8 million pots for €23.2 million) (<https://www.valhor.fr/>)

etudes-statistiques/etudes-de-marche-et-dopinion/infographies-vegetaux/). These demands are insufficiently covered by the French production. Actually, the balance of trade is strongly in deficit: approximately -€122 million for cut flowers and -€10 million for rose plants per year these three last years (<https://comtrade.un.org/data/>).

Production

The production of garden roses dominates and represents approximately 800 ha in France, with a large area of production in Doué-en-Anjou, close to Angers (Box 1). Cut flower production, estimated at 190 million stems in 2007, is essentially concentrated on the Mediterranean coast. The French Interprofession of ornamental horticulture, floristry and landscaping (Val'Hor) is a professional organisation, recognised by the

French State, uniting all the companies in the ornamental sector. It allows the financing of collective actions that contribute to the dynamism of the sector. In 2015, the 'Label Rouge' approach (guaranteeing a higher level of quality than that of other comparable products) was introduced for sale of rosebushes. About fifty cultivars are deemed eligible for the label. The introduction of the 'Fleurs de France' label in 2017 makes it possible to certify the origin and the eco-responsible process of production, responding to the development of a 'slow flower' movement. The production of rose in France would be incomplete without at least mentioning the cultivation of *Rosa × centifolia* for luxury perfumery, which is part of the skills related to perfume in the Pays de Grasse (Côte d'Azur), recognised as Intangible Cultural Heritage of Humanity by Unesco.

Selection

Rose breeding is particularly dynamic in France. Currently, some 20 breeders/creation companies are listed (https://societe-francaisedesroses.asso.fr/fr/filiere_roses_obtenteurs.htm), with diverse profiles. Some of them are direct (Ducher) or indirect successors (via takeovers, e.g., Guillot with Sirphe company) from rose-growing families of the 19th or early 20th century (Box 2). Others, already well-known, have obtained their first creations over the last 30 years (Adam, Félix, Lebrun, for example). Rose plant breeding activities can be partially monitored by studying the number of Plant Variety Right (PVR) applications present in the CPVO Variety Finder database (Community Plant Variety Office, headquarters in Angers, France). Since 2001, an average of 20 French PVR has been registered for *Rosa* sp. per year,

Box 1. Production in Doué-en-Anjou, a production basin of garden roses for more than two centuries

Doué-en-Anjou (between Angers and Saumur) is the leader in France. In 2011, about 80 producers (500 ha) produced nearly 5 million rosebushes per year corresponding to around 15% of the European garden rose production. The Doué production benefits from a local terroir and a particular know-how in the grafted roses production on *Rosa multiflora* and on *Rosa* 'Laxa' rootstocks. The quality of the roses grown in the region is particularly adapted for the production of garden roses in pots. The varietal choice approaches the thousands of different varieties grown in the region. Research into new varieties and new cultivation techniques is ongoing to adapt to new market requirements: naturally resistant varieties grown with respect to the environment. In 2018, a collective of seven rose producers (Bardet, Bon Temps, Chastel, Harpin, La Saulaie, Leroi and Oriot) created the publishing company 'Select Roses SAS' to ensure the promotion of varieties of roses that will be exclusive 'Douessines'.



> Christophe Travers, manager of Les Pépinières de la Saulaie, receiving the participants of the VII International Symposium on Rose Research and Cultivation in 2017 (credit A. Grapin).



> Producers words: "I have been managing Chastel Nurseries since 2015. I am committed to modernising the company's production while maintaining the quality that has made its reputation for nearly 30 years. At Chastel Nurseries, we grow more than 600 varieties and maintain an expertise in the production of stem and weeping roses. Everything is done to ensure quality production from the best varieties, with an adapted cultivation itinerary that is constantly evolving to reduce our environmental impact." Jean-Loup Pohn, www.pepinieres-chastel.com (credit Chastel Nursery).

Box 2. Two well-known rose breeding companies in France

PÉPINIÈRES ET ROSERAIES

Georges Delbard

Malicorne, in the centre of France, is the location where the rose varieties are created by Georges Delbard nursery. Each year, more than 30,000 flowers are manually pollinated between April and June to create a total of 80,000 new genotypes of roses for cut flowers and 60,000 for garden roses. This is followed by a period of 8 to 10 years during which the roses will be carefully observed in different soil and climatic conditions and selected to result in a dozen varieties that will be marketed. Since 1935, Georges Delbard company is at the origin of many successful varieties. Some of them have won national and international awards, such as Château de Cheverny® Deljaupar, winner of the SNHF Grand Prix for roses in all categories in 2017 and elected 'Rose of the year 2021' by the prestigious Royal Horticulture Society. As part of its ongoing drive for innovation and continuous improvement, Georges Delbard company maintains a close relationship with public research. In particular, by collaborating on research projects, the company aims to achieve more sustainable management of pathogens (Robio project) or to gain precision in its varietal innovation programme by using modern molecular marker technologies with the scientific support of INRAE.



› Château de Cheverny® Deljaupar, 2014 (credit: Georges Delbard Pépinières et Roseraies).



› Arnauld Delbard, founder's grandson (credit: Georges Delbard Pépinières et Roseraies).



MEILLAND

JARDIN & PARFUM

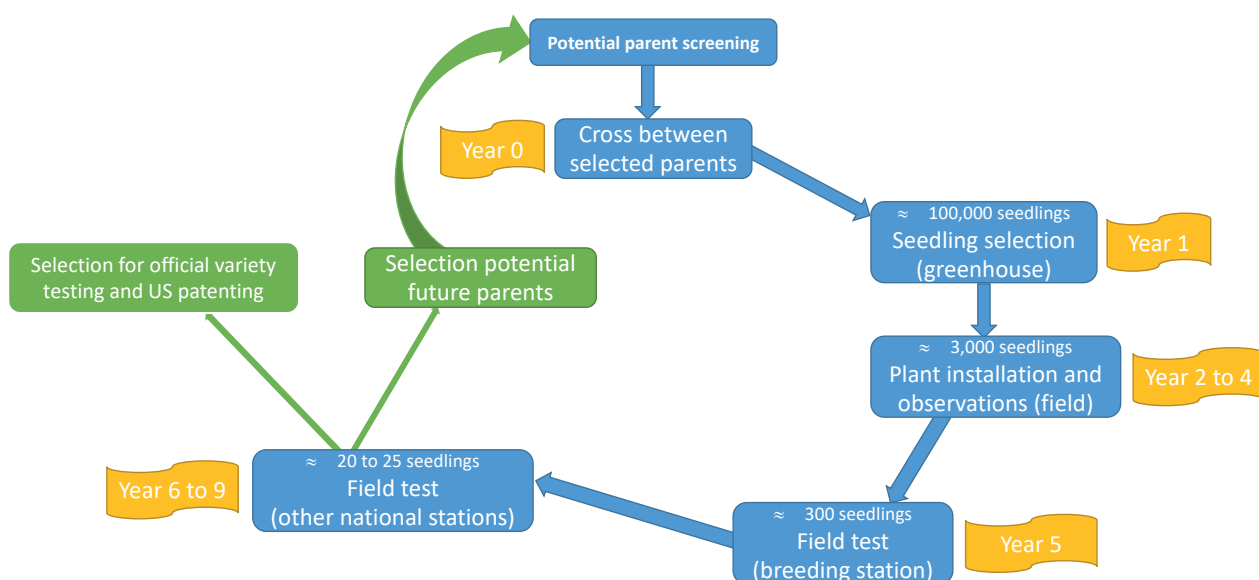
The rose is the emblematic flower of the Meilland Group. For six generations, they have been working with passion on colours, fragrances, shapes, resistance, etc., to make the rose ever more seductive. In the center in Le Cannet des Maures (France), research teams elaborate every year breeding programmes to improve the qualities of varieties. They rely on a long experience, a great expertise and an exceptional pool of genitors. Each year, between April and the end of July, 20,000 to 30,000 flowers are manually fertilised corresponding to 2,000 and 2,500 crosses. The harvested fruits allow to obtain about 150,000 to 200,000 seedlings. The plants obtained are then tested in about 15 test stations, in different climatic conditions. In the end, only ten or so varieties are marketed: an extremely demanding process that is rewarded by the fact that Meilland creations win prestigious prizes in international competitions every year. In order to value and secure investments in research, and thus continue to innovate, they take care to protect their creations. Meilland's varieties are the subject of patents, Plant Variety Certificates and trademarks to ensure their promotion in more than 40 countries. To date, Meilland holds more than 1,000 protection titles and a portfolio of 500 trademarks.



› 'Line Renaud' MEIclusif, 2005 (credit: Meilland Roses & Creation).



› Selection meeting in a test field in 2019 (credit: Meilland Roses & Creation).



■ Figure 2. Garden rose breeding scheme (French breeder recommendations).

representing 15% of the world's PVR of CPVO. France is thus the fourth leading breeder country, after the Netherlands, Germany and Denmark, with a very strong specialisation in garden rose breeding (Widehem and Plottu, 2020).

Rose breeding is a long process that can require as much as ten years (usually between 8 to 9 years) from the first hybridisation to the commercialisation of a new variety (Figure 2). Rose breeding programmes are divided into two phases: 1) selection among a large number of seedlings in the greenhouse during the first two years, and 2) performance testing and selection in the field for garden roses from the third year on. During the first year, breeders select against weak growth, for innovative traits that are not found in the released varieties, and for floral traits like colour attractiveness and longevity, wilted flowers that do fall properly and bloom shape (Zlesak et al., 2017). In

the following years, the breeders focus on floral traits, plant development and adaptability, disease and pest resistance, tolerance to diverse abiotic stresses and multiplication capacity. Today, breeding for garden roses is mainly focused on pest resistant plants. Black spot is a major pest causing foliage damages thus reducing the aesthetics of the plant (Leus et al., 2018).

Wild endemic genetic resources of roses are preserved in France by "Conservatoires botaniques nationaux" (i.e., national botanic conservatories). Varieties are preserved by public or private rose gardens, as *Roseaie du Val de Marne* in l'Haÿ-les-Roses near Paris, *Roseaie Loubert* in Gennes-Val de Loire, 30 km far from Angers, *Roseaie du parc floral de la Beaujoire* in Nantes, and *Roseaie du jardin botanique de la ville de Lyon*. Scientific resources like families for QTL mapping, and DNA of all types of accessions (wild, cultivated, scientific) are preserved by the BRC "Pip

fruit and roses" described by Roux-Cuvelier et al. (2021).

Rose gardens, in addition to preserve patrimonial genetic resources, also participate to the breeding process by organising competitions between new selections proposed by the breeders. Each competition has its own specificities. Competitions may be distinguished according to the number of locations where they take place and according to the season of the main rating. On-site competitions are organised by the rose gardens of Paris (Bagatelle, Figure 3), Lyon, Nantes and Orléans. In all cases, plants are rated by a specialised commission at different times over two years. The first three towns organise in June the final rating by a grand jury (Bagatelle and Lyon) or by a jury of perfumers (Nantes). Orléans invites in September a grand jury for the final rating, as a consequence, this competition especially distinguishes reblooming varieties. A multisite competition is organised by SNHF (Société Nationale d'Horticulture de France). New rose accessions are planted in seven different rose gardens throughout France, reflecting different types of climatic conditions. Only new varieties commercialised for less than five years may be presented by the breeders. Plants are rated during all seasons over the course of two years by specialists.

Research on rose genetics and selection in Angers

In France, many public and private players are working on research and development as in Lyon (on genomics and flower development) and in Saint-Etienne (on the metabolic pathways controlling scent production), as well as in Strasbourg with the experimental garden of the Erlén in Colmar. Angers is home to several of them.



■ Figure 3. Bagatelle (Paris) in June 2021 during the Concours International de Roses Nouvelles. It is the oldest international rose competition, first edition being in 1907 (credit Tatiana Thouroude, INRAE).

For 20 years, the Research Institute of Horticulture and Seeds (IRHS) (<https://www6.angers-nantes.inrae.fr/irhs>) has developed with the GDO team (Genetics and Diversity of Ornamentals) a genetic project to study the impacts of evolutionary history, natural selection and human activities on *Rosa* diversity and to understand genetic determinism of traits of interest.

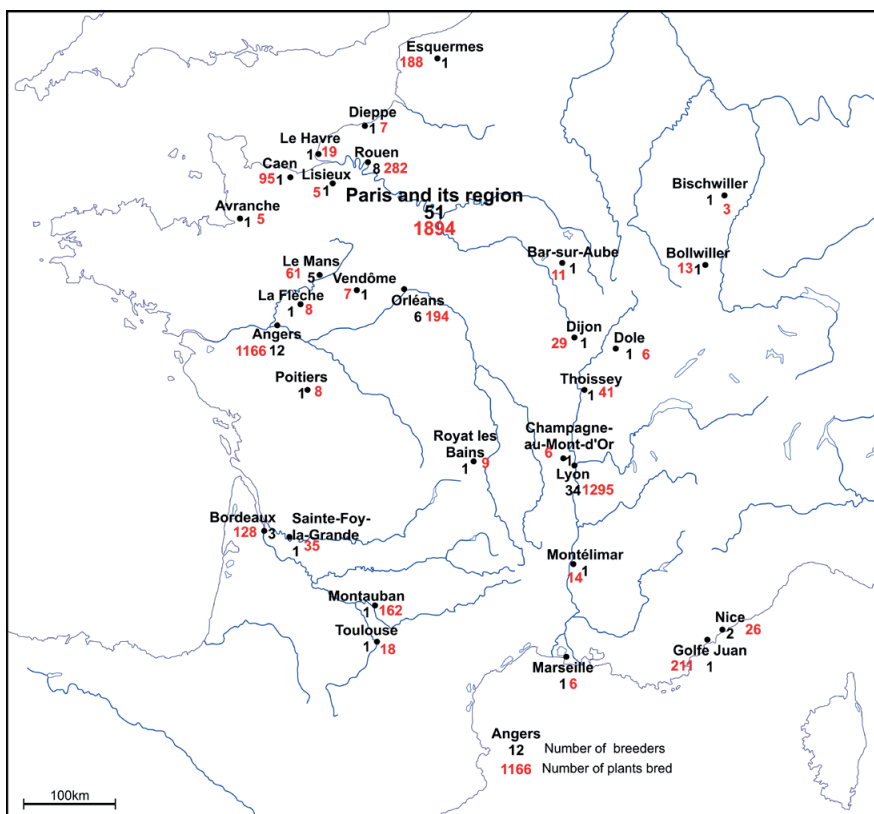
The genus *Rosa*: a complex genus for systematists and geneticists

The genus *Rosa* has more than 150 described species. Among these 150 species, about ten would have contributed to the cultivated roses that we find in our gardens or at our florists. Due to complex genetic processes (polyploidisation and interspecific hybridisation), the evolutionary history of the genus *Rosa* is still very poorly known. Using a phylogenomic approach and a step-by-step method, we were able to reconstruct a robust nuclear and plastid phylogeny of the genus, and to highlight interspecific hybridisation events and polyploidisation that generate its current diversity. We have thus resolved most of the evolutionary relationships between subgenera, sections and some species of the genus *Rosa*. For some species, such as *R. gallica*, *R. × damascena* or *R. canina*, we have proposed hybridisation scenarios using large genomic data (Debray et al., 2021)

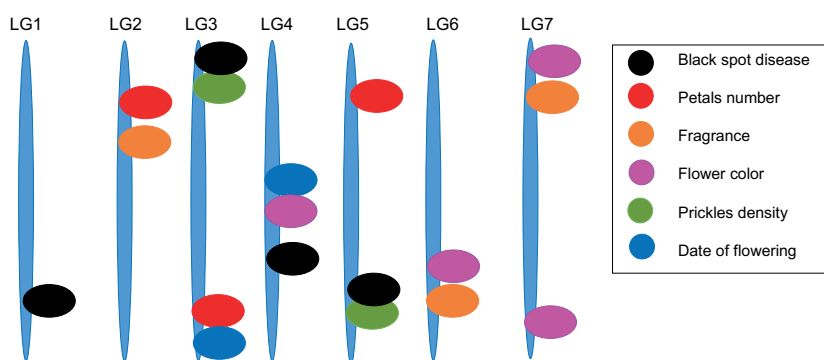
Historically, roses from the *Gallicanae* section were cultivated mainly for their therapeutic interests, in areas such as Provins, near Paris. Diversification of the *Rosa gallica* varieties increasingly developed in the first half of the 19th century and led to numerous varieties well phenotypically and genetically separated from wild accessions of French populations (see section below on rose selection during the 19th century). Questions regarding the origin of these French wild populations and more generally on the genesis (this is a putative allotetraploid) and diversity of the *Rosa gallica* species, as well as on the evolution of the relationship between the wild and the cultivated compartments through breeders' work are under investigation with C. Pawula PhD thesis (2020-2023).

Rose diversity and selection: a multidisciplinary approach

This history of rose breeding in France in the 19th century has been widely documented during the time of its protagonists (monographs, catalogues, etc.). Many roses obtained during this period are still preserved in rose gardens. This twofold observation is the starting point for the interdisciplinary approach that unites historians (TEMOS, <https://temos.cnrs.fr/>) and biologists (IRHS/GDO) to study together the creation of rose varieties over time. This began with the



■ Figure 4. Geographical distribution of breeders (in black) / number of varieties (in red) in France during the 19th century, according to Léon Simon and Pierre Cochet (1906). Cartography by Aurélie Hess.



■ Figure 5. Schematic representation of the seven rose linkage groups and the localisation of genes involved in major traits studied by the IRHS team.

FloRHiGe project (funded by the Pays de la Loire French Region) dedicated to the 19th century in France. Although roses have been cultivated since Antiquity, a strong interest in their diversification only emerged around 1800. The famous collection of roses gathered by Joséphine de Beauharnais in Malmaison in 1804-1815 (Joyaux, 2005), as well as gardening treatises, botanical writings and illustrated monographs, including the luxurious edition of *Les Roses* by Redouté and Thory (1817-1824), have fostered a new perception of the diversity of the genus *Rosa* and its horticultural potential. The popularity of roses quickly went beyond the elite's taste

for collecting plants and turned into a broad economic and cultural phenomenon: French rosomania. Initially supported by the Dutch nurserymen, rose breeding took on an unrivalled breadth in France throughout the 19th century. French breeders did not have a "type profile". The most renowned were nurserymen (Descemet, Vibert (Box 3), Jacques, Noisette, Laffay, Verdier, Schwartz, Pernet-Ducher, Guillot) or head gardeners (Hardy), but many successful varieties were due to amateurs: landowners, lawyers, retired officers, etc. The connoisseurs, both breeders and judges of novelties in horticultural shows, formed an almost exclusively male society.

Box 3. Jean-Pierre Vibert, a French breeder in the 19th century

Jean-Pierre Vibert (1777-1866) was the first French nurseryman specialised in the exclusive cultivation of roses. Former soldier in the Napoleonic army and hardware merchant (Joyaux, 2001), he acquired in 1814 and 1815 a part of Jacques-Louis Descemet's collection, consisting of 250 different kinds of roses and 10,000 seedlings. Vibert became a skilled and successful rose grower and the most prolific rose breeder, with more than 500 varieties bred and named by him, despite the misfortunes caused by the infestation of his collection by cockchafer grubs, which forced him to move his nursery in several locations near Paris. In 1839, he moved to Angers, before handing over his nursery to his head gardener, Robert, in 1851. Vibert also managed to describe his observations and practice as a breeder in some of the most informative pages of the rich literature on roses in the 19th century.

Vibert's words

"Oh, how happy was the one who first, having incidentally or intentionally placed seeds into soil, realised that nature could still vary and improve its production; but how much time one must have employed to achieve from this discovery some results less uncertain than those which mere chance would allow him! Modern worldly men, for whom the expectation of a dinner can occupy eight whole days, who only avoid boredom in the midst of the whirlwind of the great world, no, you will never conceive of such enjoyments, never will you believe that such simple pleasures can be bought by years of assiduous care. Too fortunate still if, as a price for such sustained zeal, nature does not refuse our efforts the only reward we seek! At the sight of so many marvels, how many ideas come to mind! What an astonishing spectacle offer to the good observer all these games, these variations of nature and this inexhaustible fecundity, provoked by industry, the limits of which cannot be assigned!" (our translation from Vibert, 1824).



› 'Aimée Vibert' bred by Jean-Pierre Vibert, 1828. Drawing by Annica Bricogne in Hippolyte Jamain, Eugène Forney, *Les Roses. Histoire, culture, description*, Rothschild, Paris, 1873, pl. 59, Bibliothèque Nationale de France-Gallica.

Few women-breeders received a real recognition for their merit. They were widows who ran horticultural establishments after the death of their husbands, like Marie Ducher and Marie-Louise Schwartz. The geographical distribution of French breeders (Figure 4) has evolved during the 19th century. Paris and its region constantly concentrate a high number of breeders. The North was a more active area in the first half of the century, while the South only became so after 1860. Angers was already an important centre in the 1820s, still active but surpassed by Lyon in the second half of the century.

The FlorHiGe project also highlighted the changes in horticulturists' aims and practices over the century and the path towards the quest for novelty by obtaining new rose varieties. The increase in the technical mastery of the practice of hybridisation (from hazard seedlings in the 1800s to controlled hybridisations at the end of the century) and, above all, the use of new genetic resources with innovative traits have resulted in major modifications to the phenotype of roses and

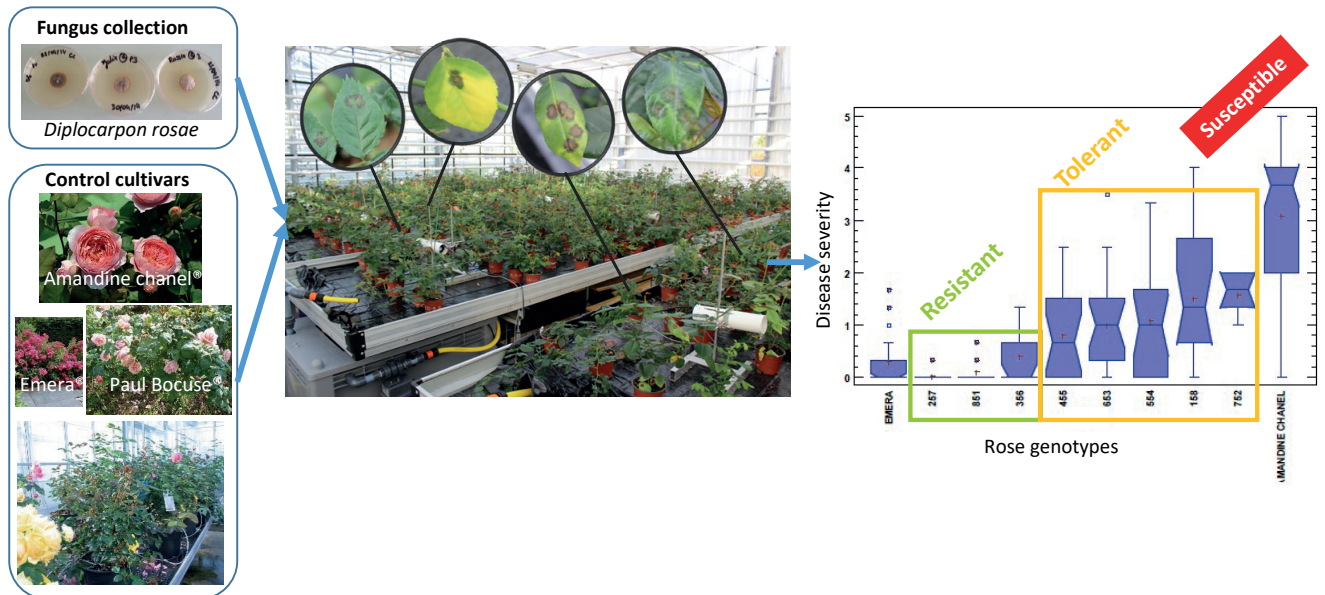
a profound change in their genotypes. It has been shown that the genetic background of European hybrid roses has gradually shifted from a genetic background close to that of ancient European roses (Gallic, Damask) to a genetic background close to that of Chinese roses, which notably gave the modern rose its perpetual blooming (Liorzou et al., 2016). Another experience of interdisciplinarity allowed the development with mathematicians from LAREMA of an approach to reconstruct pedigrees, in the context of roses with variable ploidy levels (Proia et al., 2019), during the PedRo project, conducted in the framework of the regional programme "Objectif Végétal, Research, Education and Innovation in Pays de la Loire".

RosesMonde, a recent interdisciplinary project (geography, history, sociology, economics, biology), funded by the French National Research Agency, has enabled us to broaden our understanding of the history of rose breeding and, more broadly, of the world of the rose, for the contemporary period of the 20th and 21st centuries. In addition to rose cul-

tivars, the study also focused on places and actors, in a context of market segmentation according to rose use, globalisation and standardisation of rose production and, more recently, heritage/patrimonial rose trend. The genetic work has led to an understanding of how segmentation by use and breeding time frame have structured the diversity of roses of this period.

Genetic determinism and French collaborations to understand rose black spot disease resistance

Using F₁ progeny and more recently a genome-wide association approach, several genetic studies were carried out to localise major genes and QTLs on the seven chromosomes of the rose genome, which are involved in the determinism of number of petals (Hibrand Saint-Oyant et al., 2018; Roman et al., 2015), seasonality of flowering (Iwata et al., 2012; Randoux et al., 2014; Soufflet-Freslon et al., 2021), flowering time (Kawamura et al., 2011, 2015; Roman et al., 2015), flower architecture (Kawamura et al.,



■ Figure 6. Whole plant assay in semi-controlled conditions (greenhouse) to assess the resistance of rose genotypes (Soufflet-Freslon et al., 2019; Marolleau et al., 2020).

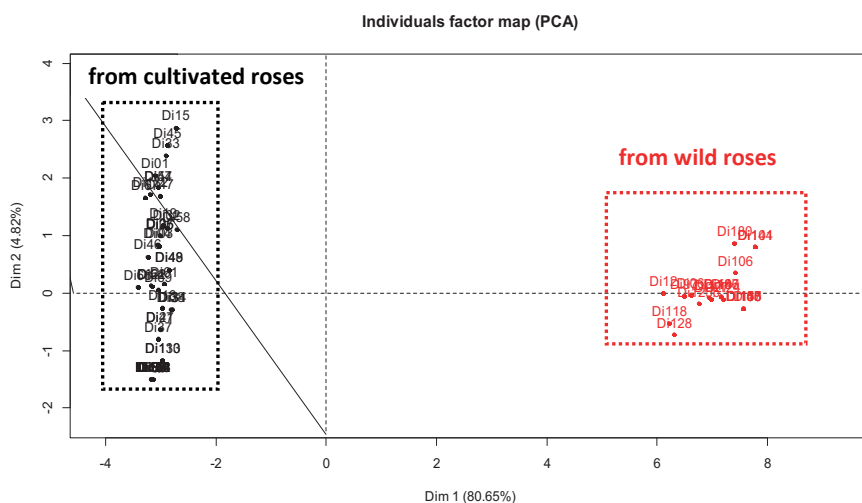
2011), plant architecture (Li-Marchetti et al., 2017), fragrance in collaboration with the university of St Etienne (S. Baudino team at the BvPAM) (Hibrand-Saint Oyant et al., 2019; Magnard et al., 2015; Sun et al., 2020), prickles (Zhou et al., 2020) and black spot disease resistance (Lopez Arias et al., 2020) (Figure 5). Moreover, the IRHS team coordinated a large international effort to obtain the first rose genome sequence of *Rosa chinensis* ‘Old blush’ (Hibrand Saint-Oyant et al., 2018), a strategic resource that will accelerate genetic research (identification of new genes, study of genome evolution). For several years, rose breeders have considered disease resistance to be one of the major traits that requires improvement in new cultivars. The need for resistant cultivars is strengthened by the need to reduce chemicals in the environment (Ecophyto plan).

Many have been prohibited in France since 2017, for landscape professionals (towns, landscape architects, public forest, roads and highways) and since 2019, for home-gardeners (Labbé, 2014). Several collaborations between French breeders, French producers, Astredhor technical institute, Vegepolys Valley (<https://www.vegepolys-valley.eu/>), IRHS-GDO and IRHS-Ecofun research teams helped to develop knowledge on black spot disease, one of the most important diseases of garden roses during several successive projects frequently supported by the French Ministry for Agriculture and Food. The “Rosa fortissima” project (2011-2013) allowed an investigation on the genetic determinism of black spot disease on F_1 cross-populations in different environments and during several years. These data were

used during the PhD of D. Lopez-Arias (2017-2020) to localise QTLs (common or specific year or environment). Notably, a meta-analysis (Biomecat, <http://moulon.inrae.fr/logiciels/biomecat/>) revealed two meta-QTLs located on linkage groups 3 and 5 (Lopez Arias et al., 2020).

Another project (“Belarosa”, 2015-2016) allowed the establishment of a greenhouse assay to characterise the resistance level of rose cultivars against black spot disease. This pathotest was first realised on a few rose cultivars, known to be susceptible or resistant, and then performed on new varieties under registration (Soufflet-Freslon et al., 2019; Marolleau et al., 2020) (Figure 6). This assay in semi-controlled conditions was compared to the behaviour of rose genotypes in field, which showed a good correlation between the greenhouse and the field observations (Marolleau et al., 2020). A fungal collection project (“DIRO”, 2014-2015) contributed to create a collection of 77 strains of *Diplocarpon rosae* (the fungus responsible for black spot disease), sampled from cultivated and wild roses mainly from Asia and Europe (Figure 7). Two of these strains were sequenced and allowed us to develop a microsatellite set to characterise the fungus genetic diversity (Marolleau et al., 2020) (Figure 6).

The studies on black spot disease continue with the PhD of L. Lambelin (2021-2024), which identified candidate genes and mechanisms for the resistance QTLs identified by D. Lopez-Arias during her PhD, and a current research project on the development of biocontrol products (“ROBIO”, 2021-2024) and conducted in collaboration with French producers, breeders, Astredhor and Vegenov (<https://www.vegenov.com/>).



■ Figure 7. Genetic diversity of 77 strains of *Diplocarpon rosae* isolated from cultivated or wild rose species in Europe and Asia. ACP was carried out using the data obtained with 27 microsatellite markers (Soufflet-Freslon et al., 2019).

Conclusions

Some important issues in research cannot be addressed in the usual model plants (e.g., *Arabidopsis*). Rose is an interesting model to investigate ornamental traits (such as seasonality of blooming or floral scent), durable resistance to diseases in vegetatively propagated shrubs, and to explore plant evolution (human and natural selections) in the

framework of interdisciplinary approaches (as history and genetics).

The challenge regarding foliar diseases is to develop durable resistance by obtaining pathogen resistant plants to limit the use of pesticides and developing alternatives to these (as biocontrol products, genetic resistance). These projects aim to produce fundamental knowledge on the diversification of

rose genetic resources as well as on resources on plant-pathogen interactions, but also some operational knowledge for rose garden curators, producers, gardeners and breeders thanks to the strong collaborations with different actors of the rose sector (rose gardens, technical institute, producers and breeders).

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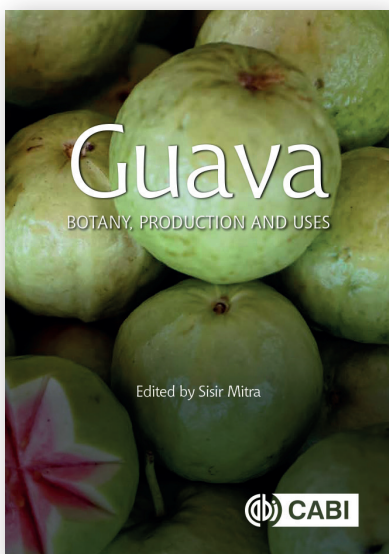


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Mitra, S., ed. (2021). *Guava: Botany, Production and Uses* (Wallingford, Oxfordshire, UK; Boston, MA, USA: CAB International), pp.380. ISBN 9781789247022 (hardback). £135.00 / €155.00 / \$180.00.

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Guava is commercially grown in more than 70 tropical and subtropical countries and is the most important “minor tropical fruit,” ahead of lychee and longan. The world production of guava increased during the last decade and was estimated at 6.75 Mt in 2017. Simultaneously, the global trade in fresh and processed guavas is experiencing promising growth, in rela-

tion to the greater attention paid to this fruit by consumers.

Despite this importance, there was a lack of publication compiling knowledge on guava biology and cultivation. The book edited by Prof. Sisir Mitra, published in 2021, in the series “Botany, production and uses” of CAB International, finally comes to meet this need. Thirty-two authors, recognized for their experience on guava and working in seven producing countries, wrote this comprehensive book covering the different aspects of guava biology, cultivation, production, and trade. The book contains sixteen chapters. Each chapter presents a comprehensive review of current knowledge, outlines future research directions, and provides a useful extensive list of old and recent references. Chapters 1 to 3 describe the taxonomy, possible origin, and relative species of the guava,