SOUTH CHINA BOTANICAL GARDEN CHINESE ACADEMY OF SCIENCES 2019 ANNUAL REPORT

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CHINESE ACADEMY OF SCIENCES

ANNUAL REPORT | 2019

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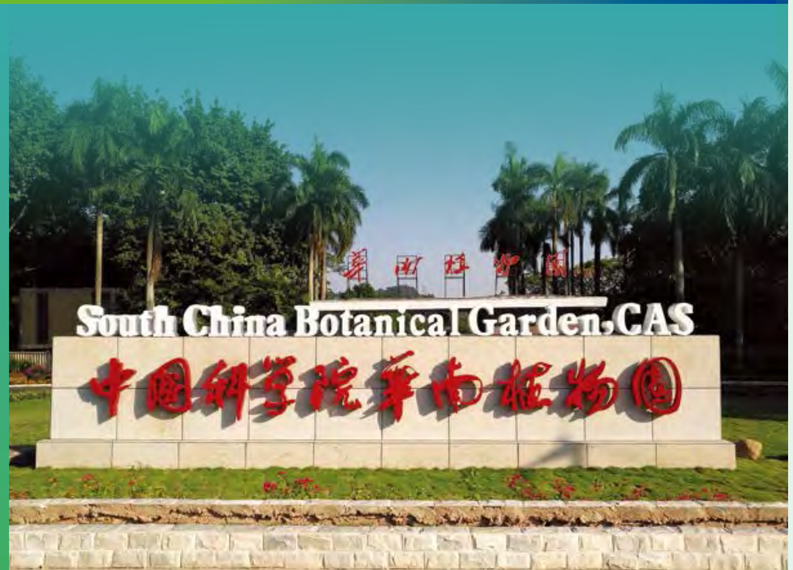
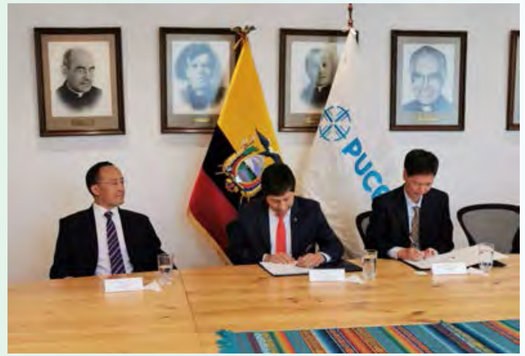


Headlines



➤ September 23, SCBG signed cooperative agreement with Pontificia Universidad Catolica del Ecuador (PUCE)

➤ September 27, SCBG signed cooperative agreement with Universidad Del Rosario (Colombia)

December 2 to 3, during the 2020-2030 International Strategic Review of SCBG, the strategic review team investigated Dinghushan National Field Research Station of Forest Ecosystem

December 2 to 3, during the 2020-2030 International Strategic Review of SCBG, the strategic review team investigated the Herbarium

December 2 to 3, during the 2020-2030 International Strategic Review of SCBG, the strategic review team investigated the Exhibition Area

December 2 to 3, during the 2020-2030 International Strategic Review of SCBG, SCBG reported to the strategic review team

December 2 to 3, during the 2020-2030 International Strategic Review of SCBG, the strategic review team took a group photo

Headlines

December 4, SCBG celebrated the 90th anniversary

December 4, the opening ceremony of the 90th anniversary of SCBG-1

December 4, the opening ceremony of the 90th anniversary of SCBG-2

December 4, the opening ceremony of the 90th anniversary of SCBG-3

December 4, ZHANG Fusheng, the secretary of SCBG's Party Committee, chaired the opening ceremony of the 90th anniversary of SCBG

December 4, REN Hai, the director of SCBG, delivered the celebration report on the opening ceremony of the 90th anniversary of SCBG

December 4, a guest to make speech on the opening ceremony of the 90th anniversary of SCBG

"One-Three-Five" Strategic Planning

1.One clearly-defined development strategy

Based on Southern China, we are committed to plant conservation, scientific research and knowledge dissemination at national and international regions with the same latitude. SCBG will develop into a high level research institution in the fields of botany, ecology, conservation and sustainable utilization of plant resources, and will be developed into a world-class botanical garden in five years.

2.Three major R&D breakthroughs

(1) The theory and technology of rapid vegetation restoration on the tropical coral islands

(2) Current pattern and changing trend of carbon pools in forest ecosystems in China

(3) Large-scale application of fresh-keeping logistics technology for fruits and vegetables

3.Five top priorities

(1) The compilation of Ex Situ Cultivated Flora of Chinese Botanical Gardens

(2) The plant diversity evolutionary mechanism of the important family and genera at the south subtropical evergreen broad-leaved forest

(3) Response and adaptation of subtropical monsoon evergreen broad-leaved forest ecosystem to global change

(4) Exploration and industrialization of high value economic crops (Wolfberry, Dendrobium, Licorice, etc.)

(5) Gene cloning for crop safety and quality and application of high efficiency transformation technologies

Director's Foreword


Dr. REN Hai

The year of 2019 is a meaningful year, which marks the 70th anniversary of the founding of the People's Republic of China, 70th anniversary of the Chinese Academy of Sciences (CAS), as well as the 90th anniversary of the South China Botanical Garden (SCBG), CAS. At the turn of the new year and the old, on behalf of all the staff of SCBG, I would like to express my cordial gratitude and utmost respect to the leaders, colleagues and friends who have been promoting and supporting the development of SCBG.

In 2019, SCBG carried out a series of thematic education of "Remain true to our original aspiration and keep our mission firmly in mind", thoroughly implemented the spirit of the fourth plenary session of the 19th Central Committee of the Communist Party of China (CPC), and systematically summarized the work of the past 10 years in conjunction with the "One-Three-Five" interim assessment. On the occasion of the celebration of 90th anniversary of SCBG, the proposed "14th Five-Year Plan" of SCBG was highly recognized by the international evaluation committee. SCBG also actively participated in the construction of Guangdong-Hong Kong-Macao Greater Bay Area International Science and Technology Innovation Center. As a member of core botanical gardens, SCBG participated in the construction of the Innovation Academy of South China Sea Ecology and Environmental Engineering, the Innovative Academy of Seed Design and the Institute of Drug Innovation. All these provided a good opportunity for SCBG to integrate the development of four research centers and three key laboratories of CAS, and to formulate the restructuring plan of research groups, administrative and supporting departments. Cooperation agreements with the Catholic University of Ecuador and with the University of Rosario, Columbia have been signed under the witness of ZHANG Tao, the vice president of CAS.

During 2019, SCBG has worked well on "One-Three-Five" Strategic Planning and achieved the expected progresses. For example, in aspect of "Three Major R&D Breakthroughs", the 1st Breakthrough of "The theory and technology of rapid vegetation restoration on the tropical coral islands" has formed an integrated technical system and systematic solution for ecological planning, seed selection and breeding, species collocation, planting maintenance and vegetation community construction on the tropical coral islands; the 3rd Breakthrough of "Large-scale application of fresh-keeping logistics technology for fruits and vegetables" has obtained the patent technology of fruit preservation which broke through the technical barriers and promoted the export of sugar orange, mandarin orange, pomelo and lychee fruits to the European Union, Canada and other international markets. In aspect of "Five Top Priorities", the 4th Priority of "Exploration and industrialization of high value economic crops" has established the local standards of "Zhongning Wolfberry".

SCBG also chaired the national report on "Implementation of Global Strategy for Plant Conservation (2011-2020) in China", participated in the preparation of the national report on "china's Implementation of Convention on Biological Diversity" and "Global Strategy for Plant Conservation (2021-2030)" which will be released at the 15th Conference of

the Parties (COP 15) to the Convention on Biological Diversity (CBD) in Kunming in 2020.

In 2019, SCBG's funds in place for scientific research reached to 183.43 million Yuan. The number of new research projects reached to 255, bringing a total new contract fund of 202.87 million Yuan. Thereby the annual new contract fund has exceeded 200 million Yuan for three consecutive years. Among new research projects, there were 47 funded by National Natural Science Foundation of China, including two Outstanding Young Science Foundation. Totally, 435 Scientific Citation Index (SCI) papers, 256 of which were listed as top 30%, and 11 volumes of monographs were published, 49 patents were authorized and 20 new cultivars were registered. In addition, SCBG ranked in the global top1% of Essential Science Indicators (ESI) in the disciplines of Plants & Animals, Agriculture and Ecology & Environment. Engineering Laboratory for Vegetation Ecosystem Restoration on Islands and Costal Zones of CAS and Guangdong Research Station of Vegetation Ecosystem on Coral Islands in South China Sea were newly established to support future development.

SCBG has won one Second prize of 2019 National Science and Technology Progress Award as the third participant unit. SCBG was also honored as 2019 National Award of Botanical Garden Excellence in Memory of Prof. Chen Fenghwai by Botanical Garden Conference of China. With regards to the National Field Station, Dinghushan Station was ranked as the excellent and Heshan Station was ranked as Good during national evaluation.

The number of talents has been increasing, with a total of 19 talents recruited in 2019, including two overseas renowned scholars and one foreign associate professor. One Scientific and Technological Innovation Leading Talent, one Young Top-notch Talent, one Millions of Leading Engineering Talent, and one Outstanding Members of CAS Youth Innovation Promotion Association were added. One Talent of CAS rated as excellent in the final evaluation.

Postgraduate education was fruitfully conducted. There were total 430 enrolled graduate students, including 39 doctoral students and 86 master students newly admitted in 2019. With 102 students graduated in 2019, two doctoral students won the Dean's Award for Excellence and several were awarded other scholarships. The graduate student union was awarded the Outstanding Student Union by the University of Chinese Academy of Sciences (UCAS). SCBG was also leading the development of the first level discipline of forestry in UCAS.

Plant introduction and conservation has made good progresses, with about 1,703 new accessions introduced in 2019. Currently, total 36,420 live accessions and 17,543 conservation taxa are in archive of SCBG. Meanwhile, SCBG has done a great job in science popularization and tourism services. In 2019, a total of 157 public education activities and 98 science communication courses were held. The total number of visitors reached to 2.23 million, including 1.12 million in Dinghushan National Nature Reserve. SCBG also won the honor of 2018 Top Ten Popular Science Education Bases of Guangdong Province.

The party committee consistently paid great attention to "Three-Importance and One-Large", "Three Meetings and One Class"of party branches, and party member education. SCBG vigorously promoted patriotism spirit by carrying out a series of activities, such as compiling the 90th anniversary anthology and album, making a promotional video, establishing a party construction theme, interviewing senior scientists for the column Oral History, etc. Over 90 collective or individual awards were awarded throughout the year.

2020 is the concluding year of the "13th Five-Year Plan" and SCBG will seriously review our work, make further improvements in the "14th Five-Year Plan", push forward the construction of the new branch in Mingzhu Science Park of CAS, carry out the institutional reform and restructuring, as well as promote the achievements of the "Three Majors" With firm faith, confidence, and perseverance, the staff of SCBG will push SCBG to a much brighter future!

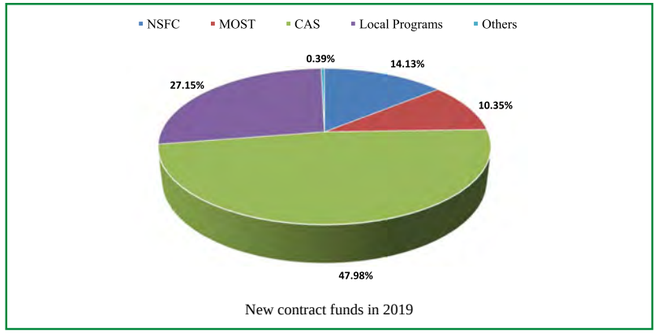
Dr. REN Hai
May 2020

Contents

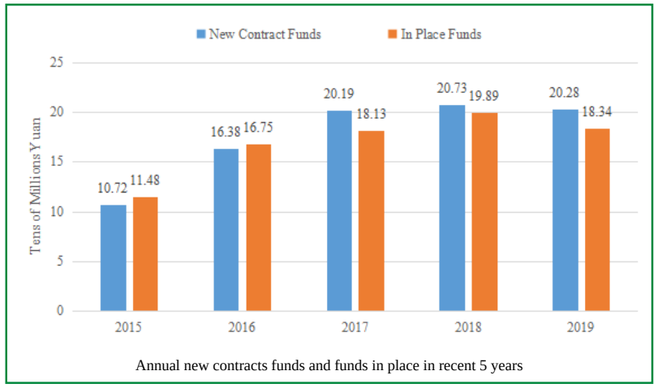
Research Achievements and Project Overview

In 2019, funds from newly contracted scientific projects reached 202.87 million Yuan. Funds in place reached 183.43 million Yuan.

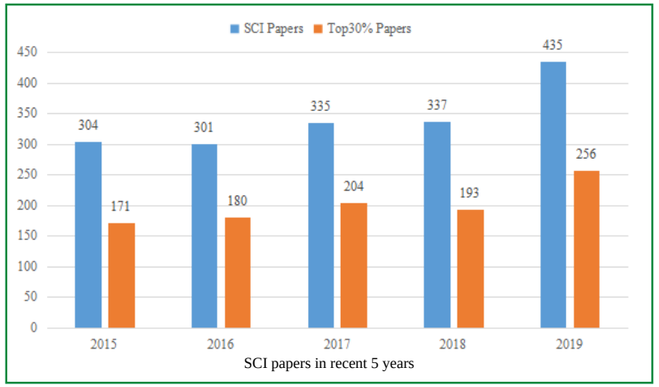
In 2019, SCBG has published 435 SCI papers, of which 256 papers were listed as Top 30%, and 10 papers had the impact factor (IF) over 10. Totally 49 patents were authorized, 20 new cultivars were registered, 11 volumes of monographs were published, and four computer software copyright registrations were obtained.



New contract funds in 2019



Annual new contracts funds and funds in place in recent 5 years



SCI papers in recent 5 years

Highlighted Scientific Research Progress

1. Multiple parapatric pollinators have radiated across a continental fig tree

Figs (*Ficus*, Moraceae) and their pollinating fig wasps (Agaonidae) constitute a classic example of an obligate plant-pollinator mutualism, and have become an ideal system to address questions on coevolution, speciation, and maintenance of mutualisms. Traditionally, it was thought that each fig species had its own species-specific fig wasp, and the fig-fig wasp mutualism was a classic example of the strict-sense cospeciation based on coevolution. However, more and more findings of cryptic fig wasp challenged species cospeciation and imply that fig wasp speciation maybe have the other ways, such as geographic isolation, host-shift or Wolbachia affection.

Based on this, we focused on the pollinator of a dioecious fig (*Valisia javana* Hill) to identify cryptic fig wasp using COI and ITS2 genes and analyzed phylogenetic relationship among different fig wasps and among haplotypes for each species. The results showed that the host *Ficus hirta* in Southeast Asia was the same species, but their pollinators are nine species, eight of which are sister species and speciated by geographical isolation, and 1 is host-shift species. These pollinators are allopatric or parapatric. This is the highest number of pollinators reported to date for any *Ficus* species, and it is the first demonstration of the occurrence of parapatric pollinator species on a fig host displaying continuous genetic structure. Future comparative studies across *Ficus* species should be able to establish the plant traits that have driven the evolution of pollinator dispersal behaviour, pollinator speciation and host plant spatial genetic structure. Our results are helpful to better understand the co-speciation and co-evolution mechanism of figs and fig wasps.

This research has been published in *Molecular Ecology*, 2019, 28: 2391-2405.

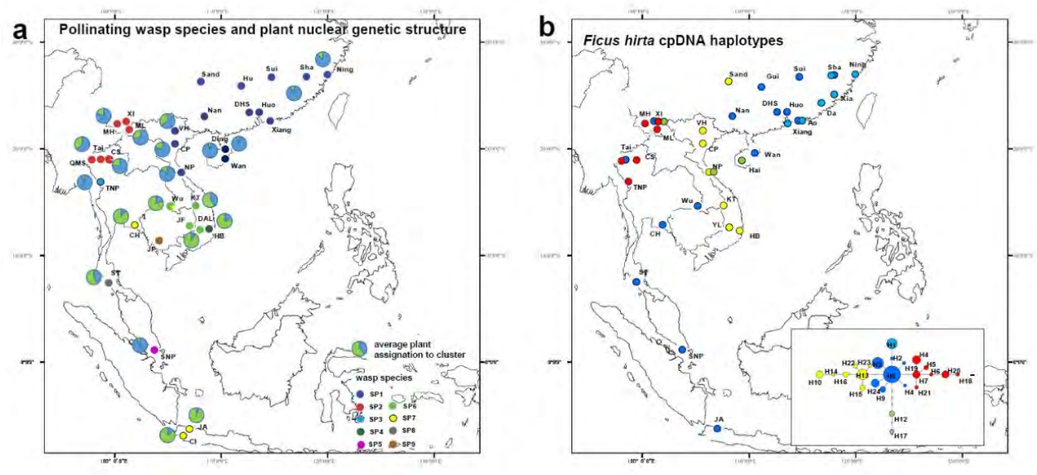


Figure. (a) The distributions of the pollinator fig wasp species associated with *Ficus hirta*. (b) The distributions of cpDNA haplotypes of *Ficus hirta*

2. The publication of the "National Standardisation System of the Chinese Botanical Gardens"

The monograph "National Standardisation System of the Chinese Botanical Gardens: Technical Code, Evaluation Criteria and Accreditation" was published by *Science Press* in June 2019. This book provided a brief introduction to the historic development and current status of the botanical gardens and arboreta in China, put forward the definitive criteria of China's botanical gardens, technical specification and professional guidelines for acquisition, ex-situ conservation, documentation and utilization. This book also proposed the evaluation criteria and accreditation for Chinese botanic gardens. The publication of this book provides a broad reference of technical standards to all kinds of botanical gardens and arboreta in China, which will promote the implementation of rigid data standards and record management, the improvement of construction planning, operation management and service quality. Hopefully this book will contribute to the high-level development in ex situ conservation, collection-based research, resource utilization, landscape and horticulture, and science education and public tourism.

3. Revealed patterns of genomic variation and underlying evolutionary processes in *Boechera stricta*, a relative of Arabidopsis

Genomic variation is widespread, and both neutral and selective processes can generate similar patterns in the genome. These processes are not mutually exclusive, so it is difficult to infer the evolutionary mechanisms that govern population and species divergence. By using whole genome re-sequencing data from 517 *B. stricta* accessions, we identify four genetic groups that diverged around 30-180 thousand years ago, with long-term small effective population sizes and recent population expansion after the Last Glacial Maximum. We find three genomic regions with elevated nucleotide diversity, totaling about 10% of the genome. These three regions of elevated nucleotide diversity show excess of intermediate-frequency alleles, higher absolute divergence and lower relative divergence than genomic background, and significant enrichment in immune-related genes, reflecting long-term balancing selection. Scattered across the genome we also find regions with high divergence among groups, which have experienced directional selection, are derived from divergent sorting of ancient polymorphisms. Our results suggest that long-term balancing selection on disease resistance genes may have maintained ancestral haplotypes across different geographical lineages, and unequal sorting of balanced polymorphisms may have generated genomic regions with elevated divergence. The research highlights the importance of ancestral balanced polymorphisms as crucial components of genome-wide variation.

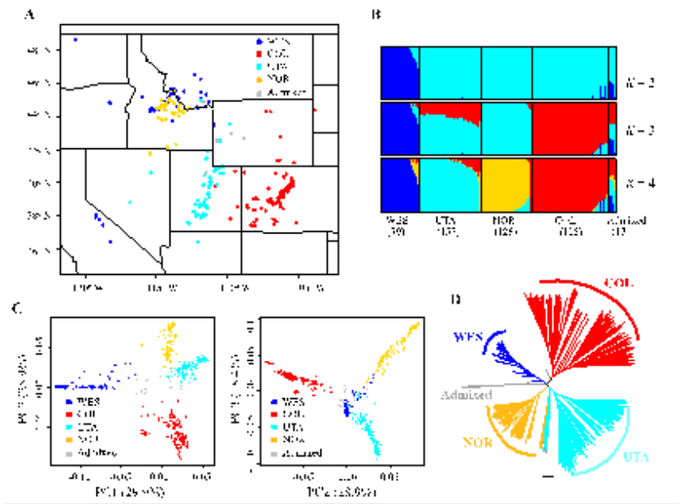


Figure. Geographic distribution (A) and population structure (B-D) of *B. stricta*

This research has been published in *Genome Biology*, 2019, 20:126.

4. Climate and litter C/N ratio constrain soil organic carbon accumulation

Soil organic carbon (SOC) plays critical roles in stabilizing atmospheric CO_2 concentration, but the mechanistic controls on the amount and distribution of SOC on global scales are not well understood. In turn, this has hampered the ability to model global C budgets and to find measures to mitigate climate change. Here, based on the data from a large field survey campaign with 2,600 plots across China's forest ecosystems and a global collection of published data from forested land, we find that a low litter carbon-to-nitrogen ratio (C/N) and high wetness index (P/PET, precipitation-to-potential-evapotranspiration ratio) are the two factors that promote SOC accumulation, with only minor contributions of litter quantity and soil texture. The field survey data demonstrated that high plant diversity decreased litter C/N and thus indirectly promoted SOC accumulation by increasing the litter quality. We conclude that any changes in plant-community composition, plant-species richness and environmental factors that can reduce the litter C/N ratio, or climatic changes that increase wetness index, may promote SOC accumulation. The research provides a guideline for modeling the carbon cycle of various ecosystem scales and formulates the principle for land-based actions for mitigating the rising atmospheric CO_2 concentration.

This research has been published in *National Science Review,* 2019, 6: 746-757.

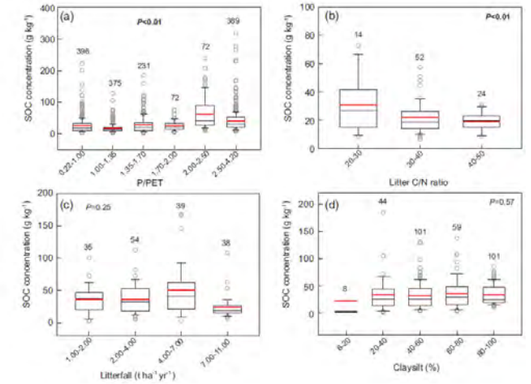


Figure 1. Boxplot showing the relationships between SOC concentrations (g C kg−1) and (a) P/PET, (b) litter C/N ratio, (c) litterfall (t ha−1 yr−1) and (d) claysilt (%),using data collected from the literature

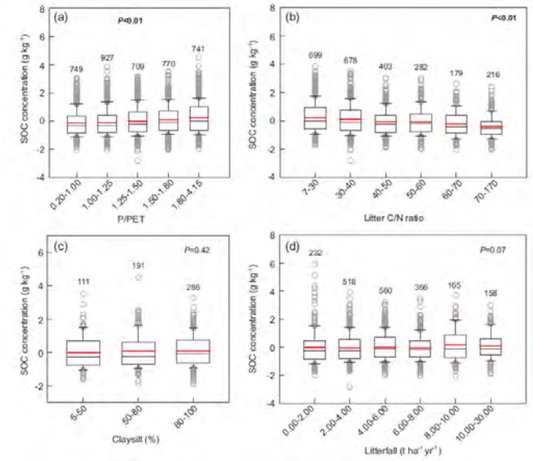


Figure 2. Boxplot showing the relationships between SOC concentrations (g C kg−1) and (a) P/PET, (b) litter C/N ratio, (c) claysilt (%) and (d) annual litterfall (tha−1yr−1), using data from both the survey of China's forest ecosystems and the published literature

5. Hydraulic traits are coordinated with maximum plant height at the global scale

Water must be transported long distances in tall plants, resulting in increasing hydraulic resistance, which may place limitations on the maximum plant height (Hmax) in a given habitat. However, the coordination of hydraulic traits with Hmax and habitat aridity remains poorly understood. To explore whether Hmax modifies the trade-off between hydraulic efficiency and safety or how water availability might influence the relationship between Hmax and other hydraulic traits, we compiled a dataset including Hmax and 11 hydraulic traits for 1,281 woody species from 369 sites worldwide. We found that taller species from wet habitats exhibited greater xylem efficiency and lower hydraulic safety, wider conduits, lower conduit density, and lower sapwood density, which were all associated with habitat water availability. Plant height and hydraulic functioning appear to represent a single, coordinated axis of variation, aligned primarily with water availability, thus suggesting an important role for this axis in species sorting processes.

This research has been published in *Science Advances*, 2019, 5: eaav1332.

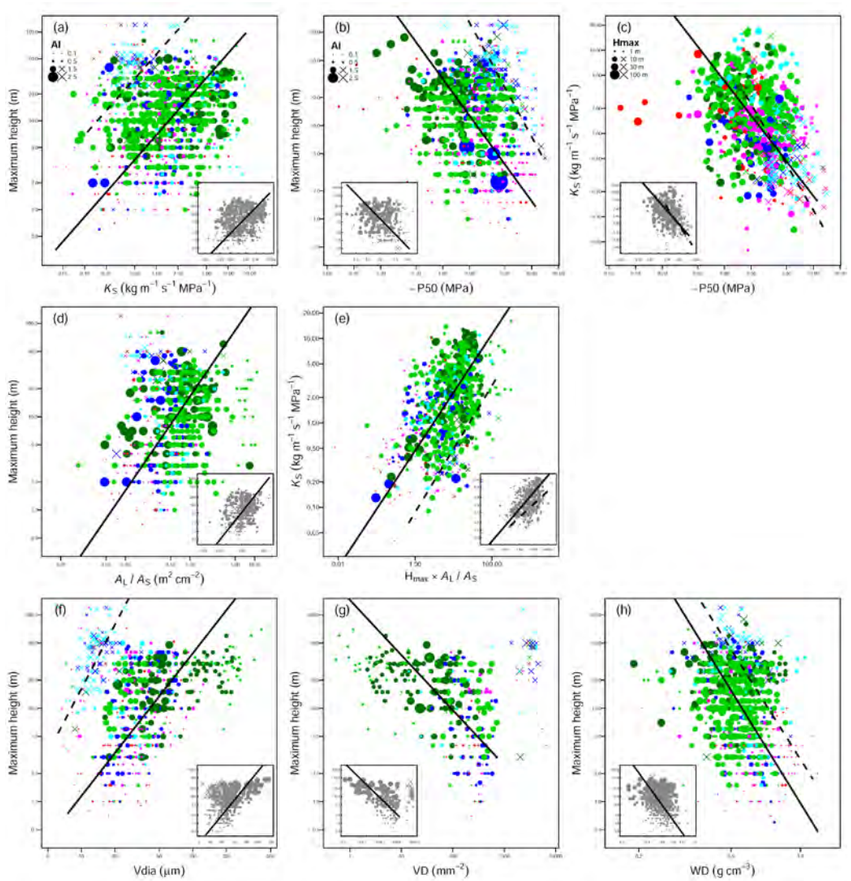


Figure. Plant height is aligned with hydraulic traits. Relationships between maximum plant height (inset figure: actual measured plant height) and (a) sapwood specific hydraulic conductivity (Ks); (b) the xylem tension at 50% loss of the maximum hydraulic conductivity (P50); (c) trade-off between Ks and P50; (d) leaf to sapwood area ratio (AL/AS); (e) the product of AL/AS and Ks (Darcy's law); (f) mean tangential vessel or tracheid diameter (Vdia); (g) number of vessels or tracheids per mm2 (VD); and (h) sapwood density (WD) across species

6. Tidal wetland resilience to sea level rise increases their carbon sequestration capacity

Coastal wetlands are large reservoirs of soil carbon (C). However, the annual C accumulation rates contributing to the C storage in these systems have yet to be spatially estimated on a large scale. We synthesized C accumulation rate (CAR) in tidal wetlands of the conterminous United States (US), upscaled the CAR to national scale, and predicted trends based on climate change scenarios. Here, we show that the mean CAR is 161.8 +/- 6 g Cm^{-2} yr^{-1}, and the conterminous US tidal wetlands sequestrate 4.2-5.0 Tg C yr^{-1}. Relative sea level rise (RSLR) largely regulates the CAR. The tidal wetland CAR is projected to increase in this century and continue their C sequestration capacity in all climate change scenarios, suggesting a strong resilience to sea level rise. These results serve as a baseline assessment of C accumulation in tidal wetlands of US, and indicate a significant C sink throughout this century.

This research has been published in *Nature Communication*, 2019, 10: 5434.

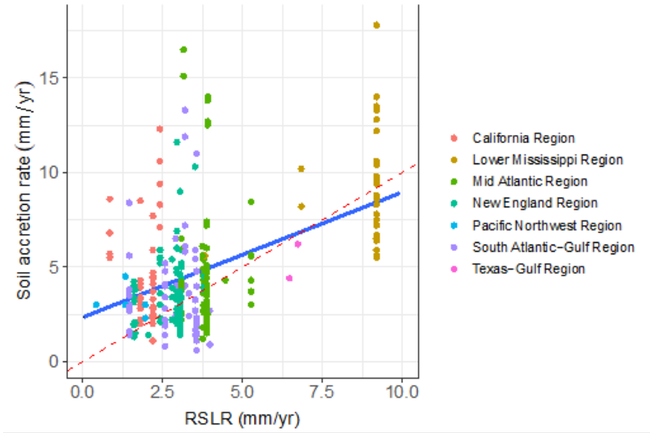


Figure 1. Comparison between RSLR and soil accretion rate (SAR) in different regions of CONUS

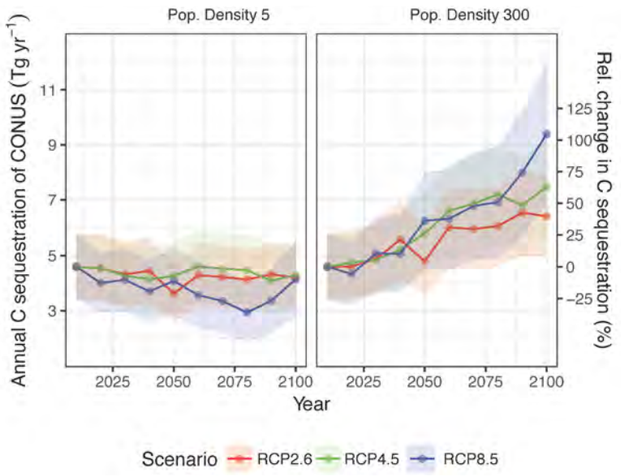


Figure 2. Estimation of total annual C sequestration of the conterminous United States tidal wetlands to 2100 based on tidal wetland area changes estimated by and projected CAR based on future RSLR under RCP 2.6, RCP 4.5, and RCP 8.5 scenarios

7. Global pattern and controls of biological nitrogen fixation under nutrient enrichment: A meta-analysis

Biological nitrogen (N) fixation (BNF), an important source of N in terrestrial ecosystems, plays a critical role in terrestrial nutrient cycling and net primary productivity. Currently, large uncertainty exists regarding how nutrient availability regulates terrestrial BNF and the drivers responsible for this process. We conducted a global meta-analysis of terrestrial BNF in response to N, phosphorus (P), and micronutrient (Micro) addition across different biomes (i.e, tropical/subtropical forest, savanna, temperate forest, grassland, boreal forest, and tundra) and explored whether the BNF responses were affected by fertilization regimes (nutrient-addition rates, duration, and total load) and environmental factors (mean annual temperature [MAT], mean annual precipitation [MAP], and N deposition). The results showed that N addition inhibited terrestrial BNF (by 19.0% (95% confidence interval [CI]: 17.7%-20.3%); hereafter), Micro addition stimulated terrestrial BNF (30.4% [25.7%-35.3%]), and P addition had an inconsistent effect on terrestrial BNF, i.e., inhibiting free-living N fixation (7.5% [4.4%-10.6%]) and stimulating symbiotic N fixation (85.5% [25.8%-158.7%]). Furthermore, the response ratios (i.e., effect sizes) of BNF to nutrient addition were smaller in low-latitude (<30 degrees) biomes (8.5%-36.9%) than in mid-/high-latitude (>=30 degrees) biomes (32.9%-61.3%), and the sensitivity (defined as the absolute value of response ratios) of BNF to nutrients in mid-/high-latitude biomes decreased with decreasing latitude ($p<=0.009$; linear/logarithmic regression models). Fertilization regimes did not affect this phenomenon ($p>0.05$), but environmental factors did affect it ($p<0.001$) because MAT, MAP, and N deposition accounted for 5%-14%, 10%-32%, and 7%-18% of the variance in the BNF response ratios in cold (MAT<15 degrees C), low-rainfall (MAP<2,500 mm), and low-N-deposition (<7 kg ha^{-1} $year^{-1}$) biomes, respectively. Overall, our meta-analysis depicts a global pattern of nutrient impacts on terrestrial BNF and indicates that certain types of global change (i.e., warming, elevated precipitation and N deposition) may reduce the sensitivity of BNF in response to nutrient enrichment in mid-/high-latitude biomes.

This research has been published in *Global Change Biology*, 2019, 25: 3018-3030.

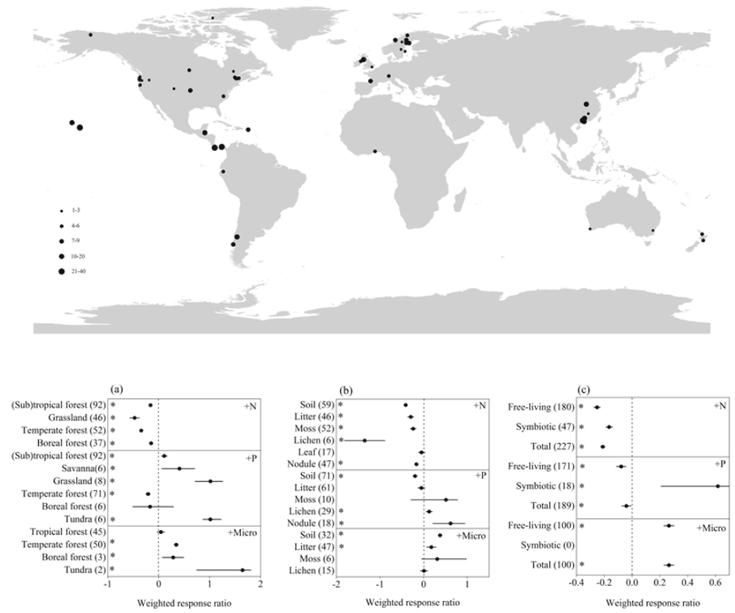


Figure. Effects of nutrient addition on biological nitrogen (N) fixation (BNF) across biomes (a), compartments (b), and N fixation types (c)

8. Leaf mechanical strength and photosynthetic capacity vary independently across 57 subtropical forest species with contrasting light requirements

Leaf mechanical strength and photosynthetic capacity are critical plant life-history traits associated with tolerance and growth under various biotic and abiotic stresses. In principle, higher mechanical resistance achieved via higher relative allocation to cell walls should slow photosynthetic rates. However, interspecific relationships among these two leaf functions have not been reported. We measured leaf traits of 57 dominant woody species in a subtropical evergreen forest in China, focusing especially on photosynthetic rates, mechanical properties, and leaf lifespan (LLS). These species were assigned to two ecological strategy groups: shade-tolerant species and light-demanding species. On average, shade-tolerant species had longer LLS, higher leaf mechanical strength but lower photosynthetic rates, and exhibited longer LLS for a given leaf mass per area (LMA) or mechanical strength than light-demanding species. Depending on the traits and the basis of expression (per area or per mass), leaf mechanical resistance and photosynthetic capacity were either deemed unrelated, or only weakly negatively correlated. We found only weak support for the proposed trade-off between leaf biomechanics and photosynthesis among co-occurring woody species. This suggests there is considerable flexibility in these properties, and the observed relationships may result more so from trait coordination than any physically or physiologically enforced trade-off.

This research has been published in *New Phytologist*, 2019, 223: 607-618.

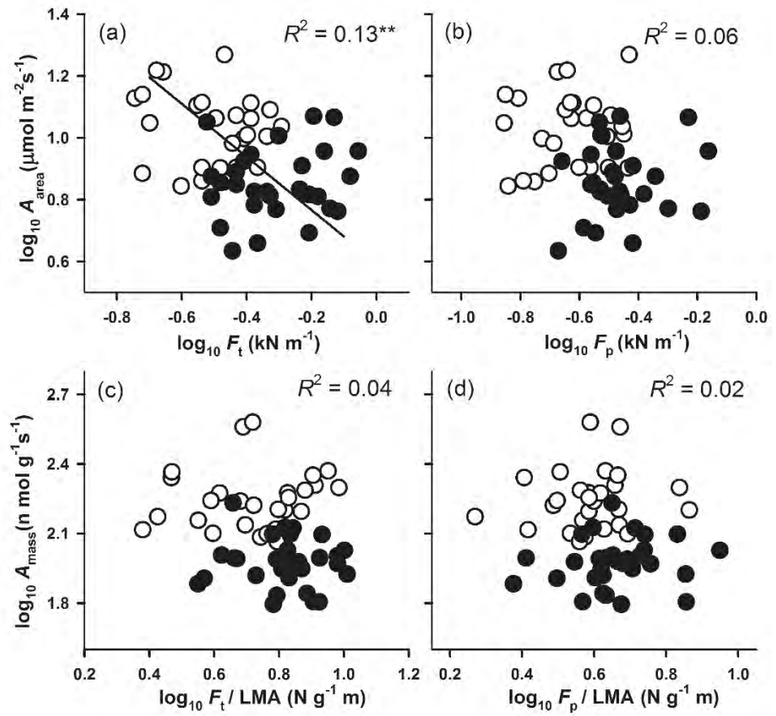


Figure. Relationships between leaf mechanical strength and photosynthetic rate across species with contrasting light requirements, considered both on a leaf area basis and a mass basis. Ft, leaf force to tear; Fp, leaf force to punch; Ft/ LMA, specific leaf tearing strength; Fp/ LMA, specific leaf punching strength; Aarea, area-based leaf net CO_2 assimilation rate; Amass, mass-based leaf net CO_2 assimilation rate. Open circles indicate light demanding species, while filled circles represent shade tolerant species

9. SCBG won the Second Prize of 2019 National Scientific and Technological Progress Award

The project "Conservation, Germplasm Innovation and Key Industrialization Technologies of Orchid Plants with Distinct Chinese Characteristics", in which SCBG as the third participant unit and Prof. ZENG Songjun from SCBG as the third participant, won the Second Prize of 2019 National Scientific and Technological Progress Award. The leading participant of this project is LAN Siren, the principal of Fujian Agriculture and Forestry University.

This is the first orchid project received the National Scientific and Technological Progress Award. Two major technological breakthroughs and four renovations were achieved, and eight key technical bottlenecks had been broken in this project.

The two major technological breakthroughs are: (1) the orchid gene silencing technology, the major bottleneck in orchid research, was discovered. Therefore, key genes in flower color and flavor regulation were identified, which lays the foundation for detailed gene function identification and designed molecular breeding; (2) *Paphiopedilum* orchid cloning *in vitro*, worldwide technical challenge, was tackled, which greatly promote the industrial scale production of *Paphiopedilum*.

The four renovations are: (1) the largest national orchid germplasm resources database was constructed according to the large-scale on-site resource survey, the new conservation strategy was developed accordingly, which successfully promoted the reintroduction of many endangered orchid species and effectively alleviated the level of endangerment; (2) the developmental relationship among *Cymbidium, Phalaenopsis, Dendrobium and Paphiopedilum* was clarified, the key genes involved in the flower color and flavor regulation were identified, and the genetic transformation systems were established, which further will promote the genetic modification of orchid species in the future; (3) the work on the innovation of breeding technology significantly shortening the breeding cycle by more than half; (4) the establishment of the efficient propagation system significantly promoted the sustainable development, transformation, and upgradation of the orchid industry.

The eight breakthroughs in the technical bottlenecks include fungal symbiotic habitat construction, reintroduction, gene silencing, breeding through *in vitro* flowering and hybridization, aseptic germination of *Paphiopedilum*, *Anoectochilus* one-time seedling, and flowering regulation. The development of these technologies has effectively cracked the major bottlenecks in orchid conservation and industrialization, promote the development of the entire orchid industry, and enhance orchid industry competitivity nationally.

SCBG has made a significant contribution to the achievements of the project. The second major technological breakthrough was mainly completed by the research group leading by Prof. ZENG Songjun.


国家科学技术进步奖
证 书
为表彰国家科学技术进步奖获得者，特颁发此证书。
项目名称：中国特色兰科植物保育与种质创新及产业化关键技术
奖励等级：二等
获 奖 者：中国科学院华南植物园
2019 年 12 月 18 日
证书号：2019-J-202-2-04-D03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奖励等级：二等
获 奖 者：曾宋君
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10. Analysis of secondary metabolites in *Averrhoa carambola* leaves

Averrhoa carambola L. (Oxalidaceae) are cultivated in tropical regions worldwide for edible fruits, and its leaves have been used as a traditional medicine. It was reported that the total flavonoids from the leaves of *A. carambola* could significantly decrease the blood sugar level and enhance glucose tolerance in diabetes mellitus rats and mice. From the leaves, 93 compounds were isolated and their structures were determined by spectroscopic and chemical methods, including 44 flavonoids (containing 22 flavone *C*-glycosides and 12 dihydrochalcone *C*-glycosides), 16 phenylpropanoids, 9 nitrogen-containing compounds, 8 megastigmanes, 6 fatty acids, and 10 others. Among them, 29 compounds were new structures, one was new natural product, and 38 known ones were reported from the genus *Averrhoa* for the first time. The characteristic and main biologically active constituents in the leaves were flavone *C*-glycosides and dihydrochalcone *C*-glycosides, which showed *in vivo* hypoglycemic effect, *in vitro* α-glucosidase and pancreatic lipase inhibitory activities, melanin formation inhibitory activity in tyrosinase reaction system, and ABTS radical cation scavenging activity. Two pure monomers of a pair of flavan-3-ol diastereomers (4 and 5) were obtained for the first time, and their absolute configurations were determined by electronic circular dichroism computation.

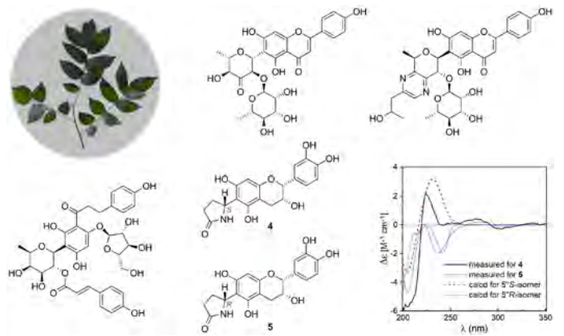


Figure. Structures of characteristic compounds in the leaves of *Averrhoa carambola*

A part of the results have been published in *Fitoterapia*, 2020, 140, 104442 and *Phytochemistry*, 2020, 174, 112364.

11. Research progress on visualization analysis of within-tissue spatial distribution of specialized metabolites in tea plant

Although specialized metabolite distributions in different tea tissues has been studied extensively, little is known about their within-tissue distribution owing to the lack of nondestructive methodology. In this study, desorption electrospray ionization imaging mass spectrometry was used to investigate the within-tissue spatial distributions of specialized metabolites in tea. To overcome the negative effects of the large amount of wax on tea leaves, several sample preparation methods were compared, with a Teflon-imprint method established for tea leaves. Polyphenols are characteristic metabolites in tea leaves. Epicatechin gallate/catechin gallate, epigallocatechin gallate/gallocatechin gallate, and gallic acid were evenly distributed on both sides of the leaves, while epicatechin/catechin, epigallocatechin/gallocatechin, and assamicain A were distributed near the leaf vein. L-Theanine was mainly accumulated in tea roots. L-Theanine and valinol were distributed around the outer root cross-section. The results will advance our understanding of the precise localizations and *in-vivo* biosyntheses of specialized metabolites in tea.

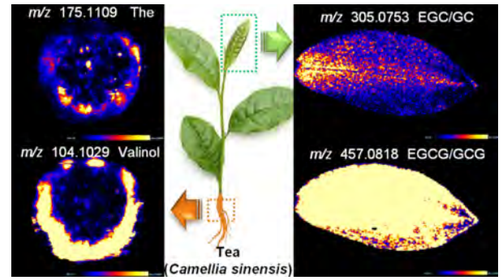


Figure. Spatial distribution of characteristic metabolites in tea leaves and roots

This research has been published in *Food Chemistry*, 2019, 292: 204-210.

12. Metabolomic data facilitating to identify anthocyanin glycosyltransferase in *Lycium ruthenicum*

The *Lycium ruthenicum* Murr fruit is a widely used nutritional food that contains various bioactive components such as anthocyanin and spermidine derivatives. In the present study, ultra-high-performance liquid chromatography with tandem mass spectrometry was utilized to profile the metabolic dynamics of four developmental stages of Lr fruit. A total of 49 compounds, including anthocyanin, alkaloids, hydroxycinnamic acid derivatives, flavonoids, and amino acids, were tentatively identified. Principal component analysis distinguished the fruit at four developmental stages using 15 potential marker compounds. Pearson correlation analysis suggested that anthocyanin and spermidine derivative hexoses had a strong positive correlation coefficient. A glucosyltransferase (HG27071) was confirmed to glucosylate both anthocyanidin and spermidine derivative in vitro. Our results provide insight into the metabolic linkages among bioactive components in Lr fruits. The glucosyltransferase identified in this study will promote its potential use in functional foods and natural pigment resources.

This research has been published in *Food Chemistry*, 2020, 311:125874.

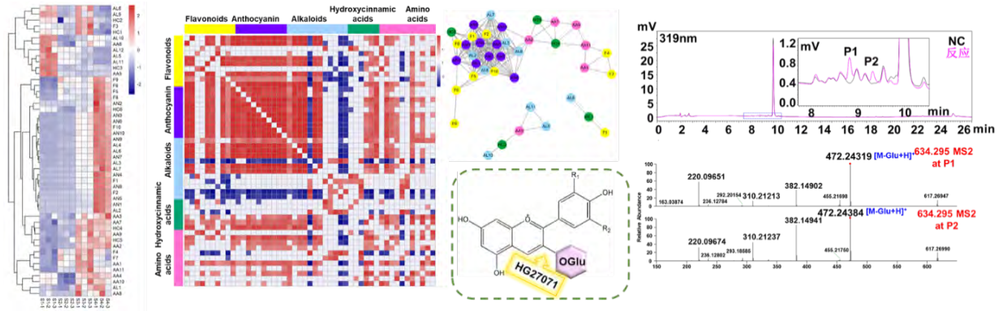


Figure. HG27071 encoding a glucosyltransferase using petunidin and spermidine as substrate

13. miR528 - a key regulator for ROS homeostasis in monocots

MicroRNA (miRNA) is a kind of small RNA molecules involved in many biological processes of plant development and stress response. A recent study has made progress in understanding the miR528-mediated regulation of ROS homeostasis in monocots. The researchers found that miR528 targets *PPO* gene and plays an important role in the cold stress response in banana. At low temperature, the decreased expression of miR528 led to a hundred-fold increase in *PPO* gene expression, which caused the increase of reactive oxygen species (ROS) level, and finally led to the appearance of banana peel browning.

Next, by integrating and analyzing all available monocotyledons genome and transcriptome (OneKP) data, the researchers found that miR528 is present in almost all monocotyledons. Unlike known conserved miRNA families, miR528 has only one copy in most monocot species, with its mature sequence highly conserved, suggesting a unique evolutionary selection process. Through further large-scale targeting prediction and data analysis, the researchers found that the gene family targeted by miR528 showed obvious preference in the species differentiation, which seemed to be dispersed to a large number of gene families, including *AAO*, *LAC*, *CBP* and *PPO*, etc. Interestingly, almost all of these miR528 target genes are copper-containing proteins. Copper (Cu) is a necessary trace element in plants. It often exists in the active center of oxidoreductases or superoxide dismutases. The contents and activities of these enzymes directly affect the ROS balance in plants, which is related to the normal development and stress response of plants. MiR528 targets copper-containing proteins in a broad spectrum, which makes it a hub regulator of ROS homeostasis in monocotyledons. On one hand, miR528 inhibits the increase of ROS by targeting *PPO, AAO, AO, LAC*, etc; on the other hand, it inhibits the decrease of ROS by targeting *POD, SOD*, etc, playing an important balancing role between the trade-off game of ROS production and elimination.

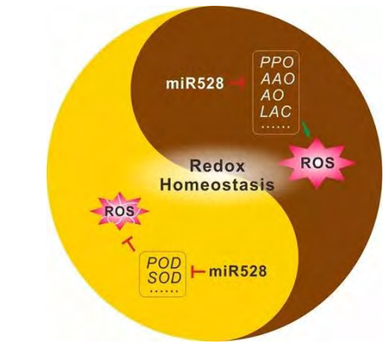


Figure. Model for the role of miR528 in cellular redox homeostasis

This research has been published in *New Phytologist*, 2020, 225, 385-399.

14. Use gene deletion/replacement,extends the flexibility of the Bxb1/Cre recombinase-mediated system

While GM crops of past years contain one to few traits, the continuous discovery of new trait genes would mean that over time, crops could end up with a large number of transgene insertions. If they were dispersed throughout the genome, extensive breeding would be needed to reassemble all of them into a single breeding line. Stacking new DNA to a preexisting transgenic locus insures that the package of transgenes can be transmitted through breeding programs as a single locus rather than as segregating loci. We previously reported on an *in planta* gene stacking method using the Bxb1 integrase for site-specific integration followed by the Cre recombinase for removal of unneeded DNA. The described method permits the sequential addition of transgenes as each integrating molecule brings a new recombination target for the next round of integration. In recent years, we have develop target lines in rice, soy and cotton for use in this gene stacking method. However, should a need arises later on that requires removal of existing transgenic DNA, one possibility would be to use sequence specific nucleases such as Zinc-finger nucleases, TALEN or CRISPR/Cas9 to cut at specific targets and induce host-mediated repair through non-homologous end joining or homologous recombination. Alternatively, we have demonstrated in tobacco that it is possible to delete or replace preexisting transgenes by the same Bxb1/Cre recombinase-mediated gene stacking system. This transgene locus editing feature extends the flexibility of the Bxb1/Cre recombinase-mediated system, and as importantly, commercial crop improvement using this gene deletion/replacement strategy has freedom-to-operate, as opposed to patent licenses needed for use of sequence specific nuclease-based tools.

This research has been published in *Plant Biotechnology Journal*, 2019, 17(11): 2021-2222.

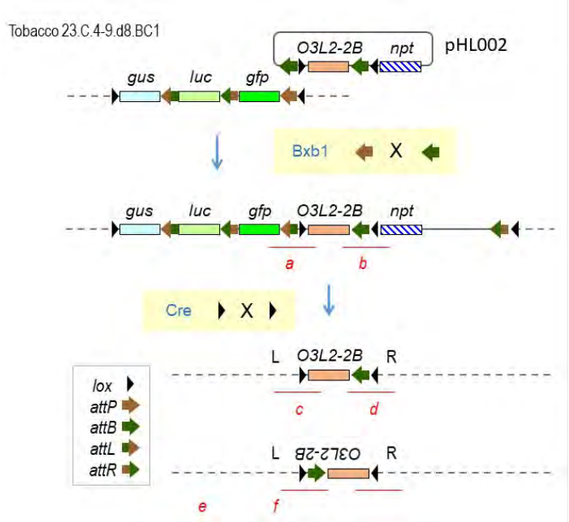


Figure. *Recombinase*- mediated gene editing

15. LjLAZY3 regulates gravitropic mechanism research in root of Lotus japonicus

Plant roots grow in the direction of the gravity vector. They can penetrate into the soil to help plants fix on the ground and absorb water and nutrients from the soil, which plays an important role in the plant response to environmental stress and morphological construction. Here we report a Lotus japonicus mutant that displays negative gravitropic response in primary and lateral roots. Map-based cloning identified the mutant gene LAZY3 as a functional ortholog of the LAZY1 gene. Mutation of the LAZY3 gene reduced rootward polar auxin transport (PAT) in the primary root, which was also insensitive to the PAT inhibitor N-1-naphthylphthalamic acid. Moreover, immunolocalization of enhanced green fluorescent protein-tagged LAZY3 in L. japonicus exhibited polar localization of LAZY3 on the plasma membrane in root stele cells. We therefore suggest that the polar localization of LAZY3 in stele cells might be required for PAT in L. japonicus root. LAZY3 transcripts displayed asymmetric distribution at the root tip within hours of gravistimulation, while overexpression of LAZY3 under a constitutive promoter in lazy3 plants rescued the gravitropic response in roots. These data indicate that root gravitropism depends on the presence of LAZY3 but not on its asymmetric expression in root tips. Expression of other LAZY genes in a lazy3 background did not rescue the growth direction of roots, suggesting that the LAZY3 gene plays a distinct role in root gravitropism in L. japonicus.

The results of this research have been published in *Plant Science*, 2019, 283:311-320 and *Journal of Experimental Botany*, 2020, 71(1):168-177.

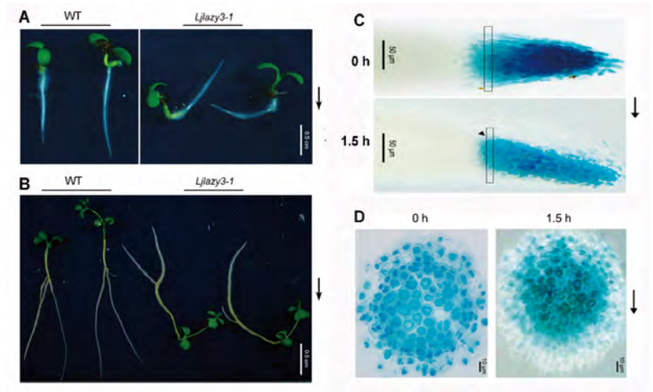


Figure 1. The phenotype of ljlazy3 and the expression pattern of LjLAZY3. A,B. Negative gravitropism of primary and lateral roots of ljlazy3. C,D. Asymmetric distribution of LjLAZY3 transcripts in the root

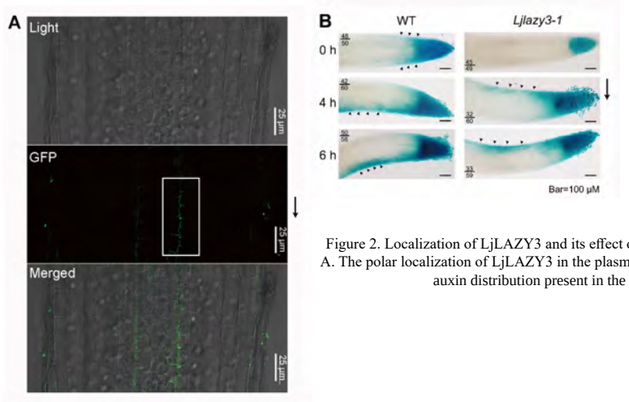


Figure 2. Localization of LjLAZY3 and its effect on auxin distribution in the root tip. A. The polar localization of LjLAZY3 in the plasm-membrane. B. Reverse asymmetric auxin distribution present in the root tip of ljlazy3

16. Gene modify can produce strongly resistant to bacterial blight of rice

Bacterial blight of rice, caused *by Xanthomonas oryzae pv. oryzae (Xoo)*, is a devastating rice disease in Southeast Asia (including South China) and West Africa. We utilized CRISPR/Cas9 to disrupt the function of *OsSWEET14* by modifying its coding region in rice cv. Zhonghua 11 (*CR-S14*). Our finding demonstrates that knockout of *OsSWEET14* in Zhonghua 11 background is able to confer strong resistance to African *Xoo* strain AXO1947. Moreover, the expression of *OsSWEET14* was detected in vascular tissues, including stem, leaf sheath, leaf blade and root. And the disruption of *OsSWEET14* enhanced the plant height and caused no yield penalty. Conclusively, we obtained genetic modified rice plants that are strongly resistant to both Asian *Xoo* strains and also African strain AXO1947.

This research has been applied for invention patent in China, the patent acceptance number is 201911250945.8.

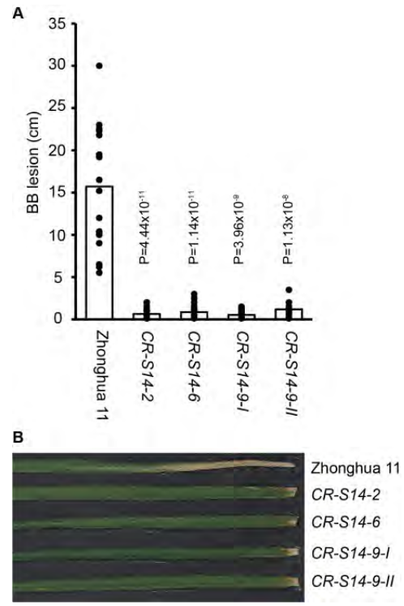


Figure. *CR-S14* confers strong resistance to AXO1947

17. Reveal a new mechanism of plants fine-tuning growth-defense balance

When attacked by pathogenic bacteria or insect pests, plants often devote more resource to activate defense response at the expense of growth. That is so called "tradeoff" between growth and defense. Previous studies have extensively reported the growth-defense tradeoff in plants and partially illuminated its regulatory mechanism. However, most of them only focused on how plants initiate the growth-defense tradeoff and paid less attention to its subsequent regulatory process. If plants reallocate resource to enhance resistance without restriction, growth and development would be arrested, even cause death. This brings us a question: how plants modulate the balance between meeting the necessary growth and achieving maximum resistance?

DELLA protein is a key negative regulator of gibberellin (GA) signaling pathway, which functions in many aspects of plant growth and development, and also participates in the regulation of plant stress response. Through a series of molecular, biochemical, and genetic evidence, this study reveals the key role of DELLA-EDS1 module in regulating

plant growth-defense balance, and proposed a hypothetical regulatory model: DELLAs maintain low abundance in plants via GA-triggered degradation during the dominant growth stage; when plants are infected by pathogens, the essential resistance regulator EDS1 is rapidly induced, which directs SA biosynthesis and the consequent resistance-related gene expression to prime/amplify the defense response. Significant SA accumulation stabilizes DELLA proteins to restrain growth, probably for resource reallocation to prioritize resistance (tradeoff). Defense is dominant during this stage; Along with infection or disease development, the increased stabilized DELLAs in turn interact with the EDS1 protein to suppress SA overproduction and excessive resistance response. Through this negative feed-back regulatory loop, plants can maintain the subtle balance between growth and defense to avoid immoderate growth or defense in response to pathogen attack.

This research has been published in *Molecular Plant*, 2019, 12:1485-1498.

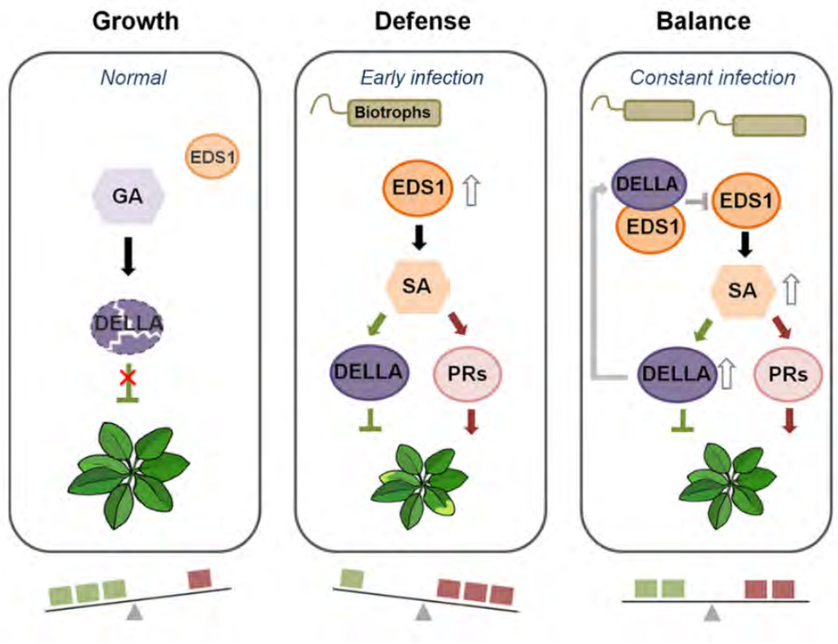


Figure. A negative regulatory loop in modulating the balance of plant growth and defense against pathogen

Talent Team Building and Postgraduate Training

Talent Team Building

1. Overall situation of talent team building

Continue to implement the "13th Five-Year Plan" of talent introduction and training, dedicatedly implement the spirit of the "1+3" talent policy of CAS, actively promote the implementation of the special assistant projects and Youth Innovation Promotion Association of CAS, focusing on the attraction of high-level talents we need, and also pay attention to the training of young and middle-age talents. In 2019, a total of 19 scientific talents were recruited, including two overseas renowned scholars, one foreign associate professor and 16 assistant professor. We have reached the working intention with three oversea postdoctors and intended to apply for the CAS talent project. According to the unified deployment of CAS, eight young reserve cadres under the age of 36 were elected.

By the end of December 2019, there were 470 registered employees, 48 postdoctors, 430 enrolled graduate students, 319 retirees, and 224 other employees, thereby the number of personnel sum up to 1,491.

2. New progress and breakthroughs have been made in personnel training and excellence promotion

To win the support from the state, CAS, Guangdong province, Guangzhou city and other talent programs, SCBG worked harder to strengthen the training of high-level talents and key young professionals. In 2019, 41 person-time applications for 19 talent programs were organized and supported, among which 14 applications were successful, including one Scientific and Technological Innovation Leading Talent, one Young Top-notch Talent, one Young and Middle-aged Expert with Outstanding Contributions of National Millions of Leading Engineering Talent Program, two National Science Foundation for Outstanding Youth Talent,one Excellent Grade Talent in the Final Evaluation of CAS, one Outstanding Members of CAS Youth Innovation Promotion Association, etc.

3. The postdoctoral research station has achieved remarkable results

With the implementation of the Special Research Assistant System and Project Enforcement Regulation of CAS and the support of Special Postdoctoral Fund of Guangdong Province, SCBG's postdoctoral research station achieved good results in terms of scientific research projects, funds as well as scientific output, and part results reached a new record. In 2019, 18 postdoctors entered while 12 postdoctors left, the current number of postdoctors in station reached 48. The daily postdoctoral funds from CAS and Guangdong Province reached 6.17 million Yuan. Per capita monthly wage for postdoctors increased 3,800 Yuan, which was significantly conducive to attracting outstanding postdoctors at home and abroad, so as to strengthen the construction of the reserve talent


荣誉证书

曾兰亭 同志：

在中国科学院植物园 2019 年学术论坛报告评选活动中获一等奖。

特发此证，以资鼓励。

报告题目：Smell of stress: 茶香的形成

Figure 1. Postdoctor ZENG Lanting won the first prize in the 2019 Academic Forum of the Botanical Garden

team. Since the postdoctoral performance award system was implemented in 2017, the postdoctoral scientific outputs, such as published papers and scientific projects, have increased significantly. A total of 56 SCI papers were published in 2019 by postdoctors (13 in 2018), including 30 listed SCBG as the first participant unit. Postdoctor ZENG Lanting won two million Yuan fund from CAS, and meanwhile won the Youth Science and Technology Award of China Tea Science Society and the first prize in the 2019 Academic Forum of the Botanical Garden.

4. Successfully completed the recruitment for professional and technical posts

According to the annual work plan, we carefully summarized the problems during the process of post recruitment in recent years, improved the "2019 Implementation Plan of Post Recruitment", and carried out recruitment for professional and technical posts in 2019 according to the personnel recruitment procedure of CAS. In 2019, a total of 122 persons applied for 152 professional and technical posts (30 of them applied for two posts). After qualification examination, 126 posts were qualified by 104 persons; with the appraisal and the approval of the SCBG administration conference, 49 persons were hired to the higher post. In order to further improve the post recruitment work, a forum was held timely after the recruitment to solicit opinions and suggestions on recruitment work from persons who competed for posts this year.

5. Successfully reformed the pension insurance system of employees

SCBG's socialization reform of the pension insurance system for employees has been comprehensively promoted since November in 2019; the employee pension insurance has officially entered the pension series of government agencies and public institutions in Guangdong province. Through policy advocacy, patient explanation, careful accounting and repeated communication, pension reform work has been recognized and supported by the majority of employees. The pension of the most retirees was slightly increased than before. In 2020, we will further complete the liquidation of insurance funds for all the employees and retirees.

Postgraduate Training

1. Overall situation of postgraduate training

In 2019, there were total 430 enrolled graduate students (highest number in history) in SCBG, including 174 doctoral students (contained seven foreign students) and 256 master students (contained nine foreign students, 14 ethnic minority cadres, seven retired soldiers, two students from Hong Kong and Macao, 20 jointly train students). There were 112 graduate supervisors.

2. Recruitment and training

In 2019, 39 doctoral students and 86 master students were admitted, the number of newly admitted students was the highest in history. Various kinds of application for government-sponsored oversea education programs were well organized in 2019 and 10 students successfully applied for the opportunities. The experimental course of "Experimental principles and operational techniques of molecular biology" was organized for the first time. Continued to standardize and deepen the course of "General education for scientific quality", Organized academic forums, theme reports, mental health lectures, and career planning guidance reports, which achieved good results. To strengthen postgraduate academic training, the 12th

SCBG Postgraduate Academic Forum was organized, more than 200 teachers and students attended, and seven master students and nine doctoral students made presentations. Outstanding students were recommended to participate in the 2019 Guangzhou Education Base Academic Report and obtained good grades. In 2019, 102 students graduated and 99 of them received degrees.

Figure 2. Courses and lectures for students

Figure 3. The 12th SCBG Postgraduate Academic Forum

Figure 4. The group photo of graduates in 2019

3. Honors and awards

In 2019, two doctoral students won the Dean's Award for Excellence of CAS; four doctoral students and four master students were awarded national scholarships; one doctoral student won the Zhuliyuehua Excellent Doctor Scholarship; one doctoral student and two master students won the Diao Scholarship; two doctoral students and three master students received BIOMIGA Scholarship; six master students won Pubang Garden Scholarship. Graduate student union of SCBG was awarded "Excellent Student Union of UCAS" .

Figure 5. Graduate student union of SCBG was awarded Excellent student union of UCAS

4. Construction of disciplines and supervisors

SCBG played a leading role in declare of first-level discipline of "horticulture" in UCAS, the demonstration report and defense have been approved by the Academic Degree Assessment Committee of UCAS. SCBG also led the first-level discipline construction of "forestry" in UCAS and was supported by a funding of 800,000 Yuan from UCAS. In addition, SCBG organized three working meetings participated by six training institutions, conducted researches on discipline construction and evaluation in other three universities, and completed the annual assessment target of 2019 successfully.

Selection and qualification of supervisors were carried out in 2019. One professor was granted the doctoral supervisor qualification and five associate professors were granted the master supervisor qualification, the results were reported to the UCAS for the record. We also organized five supervisors to apply for the Teacher Certification of Higher Education Institutions of the People's Republic of China. At present, a total of 89 supervisors in SCBG have gained the certification of teacher. In addition, we organized new supervisors to attend the seminar of supervisor held by UCAS. Prof. YE Qing was awarded the Zhuliyuehua Excellent Doctoral Supervisor by UCAS.

5. Integration of science and education

SCBG played a leading role in the construction of the department of horticulture of UCAS and organized teachers to set up five courses in agricultural department. To strengthen the integration of science and education, SCBG signed a joint postgraduate training agreement with Gannan Normal University and recommended 21 researchers in SCBG to be guest professors of Gannan Normal University.

In order to strive for outstanding students, the 7th Beauty of SCBG Summer Camp was successfully organized and 17 outstanding campers were planned to be enrolled as the master students in 2020. The 2019 CAS Student Practice Training Program was conducted smoothly, 30 undergraduate students, in 15 teams and from seven universities including Sun Yat-Sen University and Xiamen University, were enrolled. The Elite Class of Ecology and Environment was jointly conducted with Xiamen University, 10 undergraduate students were enrolled in 2019 and the second batch of 14 undergraduate students in this class completed a one-month scientific research training in SCBG.

Figure 6. The 7th Beauty of SCBG Summer Camp

6. Daily management

We paid close attention to students' physical and mental health, kept abreast of students' learning, life and scientific research and solved students' practical problems on time. In addition, we organized a number of cultural and sports activities, such as welcome party, spring and autumn tours, social practice, various ball games, English corner activities and so on.

Furthermore, we strived to do a good job in communication and service for graduate alumni. We have completed the address book of all the graduate students and alumni since 1982 and sent sincere blessings to them in the Mid-Autumn festival and the Spring Festival.

Figure 7. Cultural and sports activities

International Cooperation and Academic Exchanges

Building and maintaining international collaborations can be very effective way to share and advance knowledge. SCBG raised its international cooperation through international meetings, workshops, international talents programs and Science & Technology exchange activities. In 2019, SCBG personnel made more than 111 outbound international person-visits and received about 200 international person-visits. In addition, the number of international research collaborations continues to rise in SCBG since it is easier than ever to connect with overseas colleagues based on the One Belt and One Road Initiative and the globalization environment.

2020-2030 International Strategic Review of SCBG

On December 2 to 3, a visiting group (strategic review team) composed of 14 international botanical garden professionals convened in Guangzhou, China to assess the recent progress of SCBG and to evaluate a draft of the ten-year strategic plan for the institution.

The 14 international botanic garden experts were Stephen BLACKMORE (Chair, Botanic Gardens Conservation International, UK), Peter Robert CRANE (Oak Spring Garden Foundation, USA), Timothy John ENTWISLE (Royal Botanic Gardens Victoria, Australia; International Association of Botanic Gardens), HUANG Hongwen (International Association of Botanic Gardens), Michael Karl Maria KIEHN(Core Facility Botanical Garden, University of Vienna, Austria; International Association of Botanic Gardens), Simon Stephen MILNE (Royal Botanic Garden Edinburgh, UK), Paul Philip SMITH (Botanic Gardens Conservation International, UK), CHEN Xiaoya (Shanghai Institutes for Biological Sciences, CAS), WANG Xiaoquan (Institute of Botany, CAS), SUN Hang(Kunming Institute of Botany, CAS), CHEN Jin (Xishuangbanna Tropical Botanical Garden, CAS), ZHANG Quanfa (Wuhan Botanical Garden, CAS), Peter WYSE JACKSON(Off-site expert, Missouri Botanical Garden, USA), Markus RIEDERER (Off-site expert, University of Würzburg, Germany).

The visiting group had a thorough discussion that led to a primary assessment report in which there is no doubt that SCBG is now one of the world's first-class botanical gardens based on the impressive and comprehensive scientific

Figure 1. International strategic review of SCBG

Figure 2. Strategic review team investigated Exhibition Area of SCBG

achievements. The success of international strategic review at the SCBG encourage further international cooperation and international involvement that will lead a significant role among the world botanical garden community.

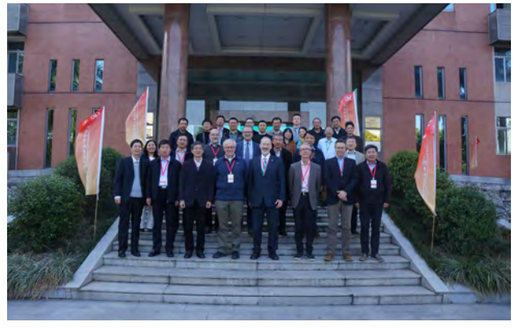


Figure 3. Strategic review team investigated Dinghushan National Field Research Station of Forest Ecosystem

Figure 4. Popularize page of SCBG published in Nature

International Cooperation

1. International cooperation with France and Italy

SCBG was jointly signed the Operation Agreement for Educational and Scientific Purposes between Italy and China with other 22 research institutions and universities in 2019.

International Associated Laboratory on "Figs and fig-wasps: a model system to investigate biotic interaction network responses to global change" was co-established in SCBG in 2019.

Figure 5. International Associate Laboratory between France and China

2. Progress of the international cooperation in South America

ZHANG Tao, the vice president of CAS, and the International Bureau of CAS visited Ecuador and Colombia to promote the collaborations of SCBG in September 2019. During the visit, we signed the Agreement for Academic Cooperation with Pontificia Universidad Catolica del Ecuador (PUCE), and Academic Cooperation Framework Agreement with Universidad Del Rosario (Colombia).

Figure 6. ZHANG Tao, the vice president of CAS, visited Pontificia Universidad Catolica del Ecuador (PUCE)

Figure 7. ZHANG Tao, the vice president of CAS, visited Universidad Del Rosario (Colombia)

Academic Exchanges and Academic Society Activities

1. Chun Woon-young Lectures Series

Chun Woon-young Lectures Series (CWLS) was initiated in 2009 and has been a very important academic exchange platform in SCBG. In 2019 CWLS was held seven times and 14 famous scientists came to SCBG to share their research progress and scientific experience. Besides CWLS, there were more than 50 lectures delivered by scientists both from China and abroad to promote academic exchange.

Figure 8. Academician DONG Xinnian report

Figure9. Academician ZHANG Fusuo report

Figure 10. Professor ZHAO Xinquan report

2. Academic society activities

Guangdong Botanical Society (GBS)

The Annual Meeting of GBS opened on December 21, 2019 in Dongguan city, Guangdong province. About 180 members from different universities and research institutions attended the meeting and about 20 people presented their research progress. For public education activities, great development has been achieved in 2019 for GBS such as organize middle school students to take plant investigation in the field, cooperate with the local government to hold nature conservation lectures and so on.

Figure 11. The Young Scholars Forum and Annual Meeting of GBS

Figure 12. The Ethnobotany Symposium and Medicine Exchange Meeting of Guangdong Yao Ethnic Minority

Figure 13. Wetland science popularization activity

Guangdong Society of Plant Physiology (GDSPP)

The Annual Meeting of GDSPP was held in Maoming city from December 15 to16, 2019. About 200 representatives from universities, research institutions and other companies in Guangdong Province even including scientists from Taiwan province joined in the meeting. And the Council Members Meeting also organized to review the annual report of GDSPP and the work plan of the next year.

Figure 14. The 7th Symposium on Plant Science and Agricultural Biotechnology and Annual Meeting of GDSPP

Ecological Society of Guangdong Province (ESGP)

The Annual Meeting of ESGP was held from December 6 to 7, 2019, wonderful academic reports were presented for about 130 participants.

Figure 15. The Conference of Green Development and Ecological Innovation in Guangdong and Annual Meeting of ESGP

Moreover, public education activities of these three societies are very fruitful in 2019.

Achievements Transfer and Transformation

Established rules and regulations to standardize the guarantee system for the transformation of scientific and technological achievements

In accordance with the requirements of "Special action for promoting the transfer and transformation of scientific and technological achievements" issued by CAS, SCBG's regulations of "Transfer and transformation of scientific and technological achievements", "External investment" and "Part-time leadership and scientific &technological achievements transformation incentives" have been revised. In 2019, we streamlined the work flow, standardized the technical development and industrialization contract template, contract review flow chart, contract seal approval form, sorted out the work flow of Science and Technology Development Center (STDC), and improved the incentive and restraint mechanism of cooperation projects. Combined with the requirement of risk prevention on incorruptible practice and internal audit work, we sorted out the risk points that may appear in the work, and formulated the prevention and control measures which effectively guarantee the smooth progress of cooperation projects.

Innovated working model to promote the cooperation between the institute and the local government and realize the company operation

Aimed at the key regions and orientation and focused on local governments' urgent demand, we innovated working model by integrating "Science and technology innovation" with "Industry chain" which contained "Capital chain", "Innovation chain" and "Industry chain", as well as forming a new diversified cooperation mode of "Politics + Industry + Learning + Research + Business" by making full use of the existing research platform and advantages. In 2019, 11 contracts were signed, with a total contract amount of 8.36 million Yuan, four of which with contract amount of 3.58 million Yuan were contracted through the efforts of STDC. Assisted researchers to negotiate and implement three cooperation projects with contract amount over 3.72 million Yuan.

Figure 1. Cooperation meeting with the municipal government of Nanchang

Figure 2. Symposium on Ningxia cooperation project

Figure 3. Sanya municipal government and forestry bureau investigated SCBG

In response to the state's call to combat poverty in the central and western regions of China, and to meet the local needs of Guizhou Province, the Southwest Guizhou Economic Plant Experimental Base was jointly constructed with the local government of Guizhou Province to transform SCBG's scientific and technological achievements. We have successively carried out the projects of "Targeted poverty alleviation through science and technology" in Southwest Guizhou, Southeast Guizhou, Northwest Guizhou and other regions and have achieved good results. The project of Yilong International Ecological Health Science and Technology Industrial Park of Traditional Chinese Medicine has been preliminarily completed, and the land and experimental building are being confirmed.

We also carried out the joint development project of economic plants in South Henan with the local government of Henan Province, focusing on the work of planting, harvesting and processing standardization of traditional Chinese medicine in South Henan; and provided technical consulting services to Tongbai County by participating in the project demonstration, planning and design of Huaiheyuan National Reserve Forest, Huaiheyuan Plant Germplasm Resource Collection and Ex situ Conservation. At present, the projects have been promoted orderly and achieved good social and economic benefits.

Figure 4. The 3rd international conference on the development and cooperation of artemisia argyi industry

Figure 5. Hejiachong industry revitalization conference

Overall planning and coordination to strengthen foreign investment management

We comprehensively integrated resources such as science and technology, finance, platforms and leading enterprises to effectively expand business formats through multi-level promotion and exchanges. Guangdong Zhongkeqilin Garden Co. Ltd., a holding enterprise of SCBG, is mainly engaged in the landscape planning and design, construction, maintenance management, the production of new excellent seedlings, and rapid propagation of plant bodies, etc. Since 2016, the total income of the company reached 491 million Yuan, the total tax payment was 35.61 million Yuan, the total profit was 13.29 million Yuan, and the net profit reached 12.77 million Yuan.

Daily management

1. Audit work

In 2019, We participated various audit work, such as the cross inspection of internal audit quality assessment organized by the Supervision and Auditing Bureau of CAS, the economic responsibility audit and the inspection of "private coffer" organized by CAS, the special audit of scientific research materials procurement organized by Guangzhou Branch of CAS, the special audit of the party membership dues and the authenticity and legality audit of scientific research economic business in SCBG, and have achieved excellent results.

2. Alliance and committee management

We took charge of the acceptance, daily management and data submission of Guangdong Provincial Characteristic Plant Resources Development Engineering and Technology Research Center, cooperated with the Green City Alliance of CAS, Smart Agriculture Alliance and other organizations, organized and coordinated the relevant matters of the Medical Dendrobium Conservation and Utilization Committee of China Wildlife Conservation Association, and participated in the branch meetings of China Wildlife Conservation Association.

Figure 6. Council meeting of Green City Alliance of CAS

3. Accounting for academic society

Completed the business accounting, annual financial report and annual tax inspection of the three academic societies affiliated to SCBG, and organized the financial audit of the Ecological Society of Guangdong Province.

4. Supervision of the investment company

Completed the monthly business reports and the annual forecast of the maintenance and increase of operational assets of Guangdong Zhongkeqilin Garden Co. Ltd. and Science and Technology Consulting and Development Service Department of SCBG.

5. Severely punished the infringements and safeguard the legitimate rights and interests of SCBG

In 2019, we received multiple reports of illegal infringements of trademark and logo of SCBG. To safeguard the legitimate rights and interests of SCBG, we released the statement on the SCBG's internal and external web site in time, sorted out the information of the company with illegal infringements, and sent Legal Opinion Letter to relevant companies to safeguard our rights through legal means.

Horticulture and Public Education

Ex situ conservation and horticulture

The Garden implemented a new living collection policy, established preliminary network of ex situ conservation, actively explored the effective models and concepts of garden landscape, improved horticultural volunteer service, and made new progress in ex situ conservation and landscape gardening.

1. Plant acquisition and conservation

Completed the annual goals in plant acquisition, identification and ex situ conservation assessment, patent and monograph research in 2019. Increased 1,703 new accessions including 533 species and 979 varieties from China and overseas. Totally propagated 4,100 pots/clusters of 1,024 taxa, transplanted 2,521 plants/clusters of 157 species, recorded phenology of 316 species, identified 126 species. Authorized two new patents and published two monographs based on living collections. Provided 17 batches of 71 species for scientific research. Completed a preliminary annual review of living collections, and currently the Garden holds 9,629 species (including infraspecific taxa) and 17,543 taxa (including 7,914 cultivars) in cultivation, of which 5,681 accessions of unidentified plants, 5,006 species and 6,929 taxa of Chinese native plants (52.6% and 72.34% of living collections), 14,717 accessions of wild taxa (42.3% of the total accessions), 877 species of rare and endangered plants, 1,246 species and 1,279 taxa of Chinese endemic plants.

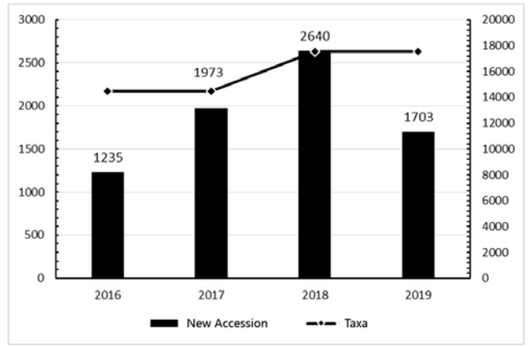


Figure 1. 2016-2019 Living collections

Figure 2. Plant phenology observation

Figure 3. Plant conservation

2. Garden landscape and horticulture

Under the overall coordination of the Core Botanical Gardens of CAS, the Garden had involvement in the development of standards for garden and gardening, dynamic monitoring system for plant growth environment and the protocols for garden tools and technical equipment, to explore new ideas and models for the construction and management of botanical gardens and specialized collections. Carried out master landscape evaluation, performed a wide range of landscape maintenance and seasonal tasks important to the preservation, protection and display of themed gardens and collections, self-financing completed landscape improvement of 16 ground sites, re-sodding of bare spots for more than 10,000 m^2 and the construction of herbaceous borders in some important sites. In accordance with the living collection policy and international assessment requirements, carried out accession record keeping and plant labeling, and added or updated 4,979 plant nameplates and 371 interpretation panels. The maintenance and improvement of the garden landscape was highly recognized. Actively managed gardening and horticultural volunteer assignments and coordination, established a team of arborists for tree-climbing training, conducted external exchanges, explored professional and models of garden tree management, and promoted the improvement of the Garden's landscape and conservation management capabilities.

Public education and tourism service

The Garden provided a diverse range of garden featured scientific activities and education courses, "Qilin Science Forum", extensive media coverage, tourism service and volunteer programs, and hosted more than 1.11 million visitors including about 200,000 teenagers, and the tickets and events income was 22.28 million Yuan.

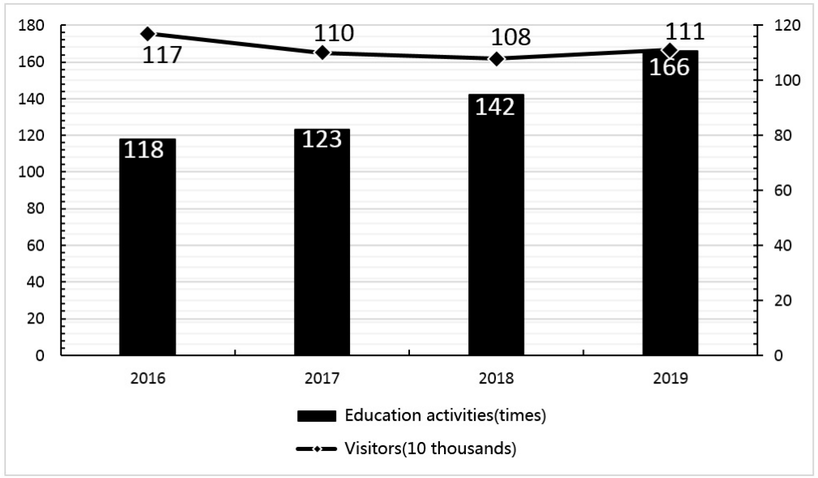


Figure 4. Statistics of education activities and tourists in 2016-2019

1. Science activities and education programs

Figure 5. "Qilin Science Forum" held in SCBG

The Garden provided a huge range of popular science activities, courses and lectures for the public to make the most out of visit to the plant resources, natural environment and scientific research advantages. Continuously carried out five series of natural education courses, including "Natural history", "Class of nature" "Press flower art", "Nature investigator" and "Plant science", with a total of 98 sessions. Hosted and participated in a total of 166 scientific activities and events of CAS, Guangdong Province and Guangzhou, including "Guangzhou Education Outreach: campus, communities, countryside and enterprises", "The 15th CAS Public Science Day & 2019 Science and Technology Activity Week", "Popular Science Carnival" on National Science Day, "The 2nd Science and Technology Festival of CAS", the "Winter/Summer Camps" etc. Established "Qilin Science Forum", including 17 science lectures; and more than 1,200 people of all ages attended in the lectures and related activities.

2. Media communication and science publicity

Regularly released "what's on" at the Garden about "Blooming information", "Scientific activities and education courses", "Plant stories" and "Scientific progress" to welcome information and navigation services for tourists and the public. In 2019, released 61 times of education activities and events in the newspapers, TVs and radios, launched 306 pieces of tourism information and reports in all kinds of networks, released 295 articles in Official WeChat with

Figure 6. Science popularization report of SCBG in the media

67,023 subscribers, and 129 pieces of official information in micro-blog with 126,860 fans. 63 flower-blooming articles, 14 times of monthly blooming and six times of conservatory blooming boards were released. The Garden was ranked forefront for popular science publicity in CAS.

3. Popular science projects and awards

In 2019, the Garden got six projects of science popularization with 1.55 million Yuan funding and awarded as 2018 Top Ten Popular Science Education Bases of Guangdong Province by Guangdong Association of Science and Technology (March), 2018 Advanced Unit of Guangzhou Tourist Attraction, 2018 Most Popular Brand of Guangzhou Tourist Attraction, 2019 Most Popular Science Base of Guangzhou (October), 2019 National Award of Botanical Garden Excellence in Memory of Prof. Chen Fenghwai by Botanical Garden Conference of China (December). Mr. SONG Zhengping was awarded 2018 Outstanding Individual of Guangzhou Tourist Attraction (September).

Figure 7. SCBG was awarded as 2018 Top Ten Popular Science Education Bases of Guangdong Province

Dinghushan National Nature Reserve

In 2019, Dinghushan National Nature Reserve (Dinghushan Arboretum of CAS) conscientiously implemented the "Opinions on the Establishment of a Natural Reserve System with National Parks as the Main Body", strongly perform the functions of nature protection, scientific research and monitoring, popularization of science, platform management and service, and made good progress.

Nature Protection

On the basis of doing daily work well, such as guarding and patrol, publicity and training, inspection and supervision, and prevention of smuggling and poaching, Dinghushan National Nature Reserve actively took measures to deal with the challenges on holidays (especially on Tomb-Sweeping Day and Double Ninth Festival), strong typhoons and other security nodes. In second half of 2019,101 consecutive days without rain led to the highest level of forest fire risk. To reduce fire risk, a great deal of special measures were taken, such as closing the open area during the night, registering all the car and the visitors entering the nature reserve, and signing the forest fire prevention responsibility statement with visitors, adding night patrol, strictly controlling the constructions that were not urgent. One mountain fire caused by construction in night was timely controlled and extinguished. The above works ensured that there was no forest fire and major safety accidents throughout the year, and the natural resources and environment were well protected.

In accordance with the law and regulations, the scheme for boundary settlement of Dinghushan National Nature Reserve was finished. The boundary of the ecological public welfare forests was confirmed according to the requirements of Guangdong Forestry Bureau. Works related to "Green Shield 2019" and the nature reserve inspection were done well. Dinghushan Biosphere Reserve Management Plan (2020-2029) was compiled according to the requirements of International Advisory Committee of UNESCO "Man and Biosphere Program".

Figure 1. 2019 Forest Fire Emergency Drill of Dinghushan National Nature Reserve

Scientific Research and Monitoring

Continue to carry out animal monitoring with infrared camera and insect monitoring. *Wild Plants in Dinghushan* and *Guide to Common Birds in Dinghushan* were published. A total of 76 research papers, which were finished partly or fully based on Dinghushan, were published in various international mainstream journals, including *Ecology Letters, Global Change Biology, New Phytologist, Tree Physiology* and *Plant Soil.*

Six new species were found according to type specimens collected from Dinghushan, including *Russula pseudobubalina*, *Russula subatropurpurea, Russula bubaline, Russula viridicinnamomea, Russula pseudocatillus, Agaricus rubripes*. The distribution of nine newly recorded species was detected, including six species of butterfly species, such as *Dichorragia nesimachus, Horaga albimacula, Heliophorus kohimensisi, Orthomiella rantaizana, Hasora anura, Notocrypta paralysos,* as well as three species of other insects, such as *Ourapteryx clara, Ascalaphidae pp. and Erebus crepuscularis. Manis Squama* was found again.

Scientific Research and Monitoring

Dinghushan Bamboo Garden has been upgraded. About 81 species of bamboo subfamily have been introduced, and the matching education facilities have been installed.

Knowledge Dissemination and Scientific Popularization

A total of 15 research and learning practice education activities for 3,600 primary and secondary school students were organized. The research and learning practice education project supported by Ministry of Education was finished and rated “excellent”.

Dinghushan Nature Reserve was the first nature reserve of People’s Republic of China and was selected into the “Eighty Firsts” since the founding of People’s Republic of China. To celebrate the 70th anniversary of the founding of the People’s Republic of China, more than 20 news reports or TV shows about Dinghushan by China Central Television (CCTV), Zhaoqing TV Station, Dinghu District Station, People’s Daily, Xinhua News, Nanfang Daily, Guangzhou Daily, Yangcheng Evening News, Xijiang daily and etc. were released. “On June 30, 1956, the first nature reserve – Guangdong Dinghushan National Nature Reserve was established” was recorded in the events chronicle of the People’s Republic of China.

FAN Zongji was awarded the 2019 China Biosphere Reserve Network Youth Science Award by the Chinese National Committee for Man and Biosphere.

Figure 2. Research and learning practice education activities

Figure 3. A delegation from the Chaipattana Foundation in Thailand visited the Reserve to experience the beauty of ecological conservation and forests

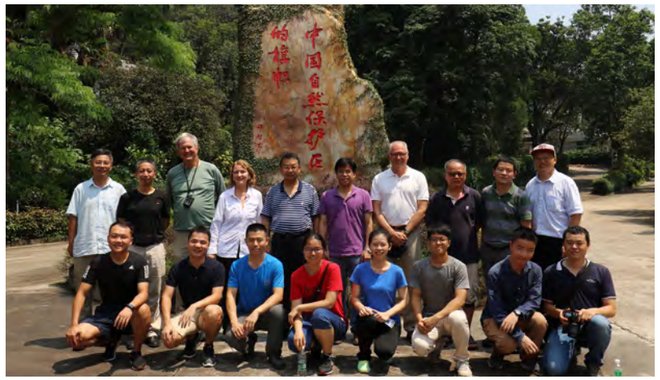


Figure 4. The 2019 Science Popularization Work Exchange Meeting of Guangzhou Branch was successfully held in the Reserve

Figure 5. FAN Zongji was awarded the 2019 China Biosphere Reserve Network Youth Science Award

Party Building and Innovative Culture

There was 12 party branches and 476 party members of CPC in SCBG. In 2019, SCBG won 90 honors respectively from the state, CAS and Guangzhou City. SCBG's propaganda work of party building ranked 11th in CAS. The party committee of SCBG has made solid efforts to carry out the theme education of "Remain true to our original aspiration and keep our mission firmly in mind" throughout the year, so as to provide strong political guarantee and ideological motivation for the implementation of "One-Three-Five Plan" and the construction of Core Botanical Garden, and make a good function of party organizations as battle bastions.

Continue to deepen ideological construction

SCBG has made solid efforts to carry out the theme education of "Remain true to our original aspiration and keep our mission firmly in mind". Combined theory with practice, the central group of party committee explore the establishment of a national botanical garden management system with Chinese characteristics, promote the construction of the Core Botanical Garden and work to service the development of Guangdong-Hong Kong-Macao Greater Bay Area. Adhered to the problem-oriented approach, focused on reform and development, the central group of party committee sorted out 19 problems that need special rectification through rectification and "Looking Back" The party committee, together with the administrative leadership, summarized the work of the past 10 years and carried out a great deal of work such as proposing the "14th Five-Year Plan" of SCBG, carrying out international evaluation, promoting systematic reform of the research groups, administrative and supporting departments.

Figure 1. Meeting for theme education of "Remain true to our original aspiration and keep our mission firmly in mind" (August 27, 2019)

According to the inspection requirements of CAS, SCBG has set up a working group with five teams, which specially inspected the problems of party construction, personnel, finance, infrastructure and research ethics and then supervise the rectification timely. At the same time, SCBG continued to deepen the efforts to correct the "Four forms of decadence" and addressed the prominent problems of formalism.

In order to better implement democratic centralism, SCBG formulated a series of documents to standardize the content and scope of "Three-Importance and One-Large" and the working procedures of the party committee. Ideological construction has been incorporated into party construction and comprehensive departmental assessment. Items such as important meetings, thematic education, position changes of party committee members have been reported as required.

Strengthen organization construction with advantage

SCBG carried out featured thematic activity annually to promote the spirit of scientists and lead the development of research institutes. The theme of 2019 is "Enhancing capacity and strengthening responsibility" , and the activities including "Carry forward the spirit of scientists and carry out the spirit of the new era of CAS" , "Strengthen the sense of discipline and patriotism"and other party activities.


Figure 2. Voluntary activity carried out by party branches (November 22, 2019)

SCBG also laid emphasis on organization construction of the party branch, the branch secretary were permitted to attend the party committee central group study. In 2019, two party branches were reelected, and special training was conducted for the new committee members. Laid emphasis on theoretical learning, learned documents such as "Regulations on the education and administration of CPC members" , "Opinions of the CPC central committee on strengthening the party's political construction"and "Regulations on the work of party branches of the communist party of China (trial)" . Laid emphasis on party member development, five probationary members were recruited, and two probationary members became full members as scheduled.

ZHANG Fusheng, the secretary of the party committee and discipline inspection committee, and the staff of party committee office frequently investigated the branches in order to find and rectify the weakness in time. The weakness about "Three-meetings and One-lesson" such as incomplete records, no branch work plan and lack of party class records were rectified under the guidance. They also focused on the assessment of branches.

Take solid steps to build a fine party culture and a corruption-free party

The leading group of SCBG earnestly fulfilled the responsibilities, leaded the construction of fine party culture and corruption-free party, and improved their work according to the opinions and suggestions from two democratic life meeting.

Figure 3. Discipline education activity (August 22, 2019)

The discipline inspection committee assisted the party committee in carrying out discipline education activities. ZHANG Fusheng made a report to party members entitled "Have a clear understanding of the anti-corruption struggle situation and make efforts to create a fine scientific research culture", to remind researchers to avoid illegal behavior and academic

misconduct. REN Hai, the director of SCBG made a report entitled “The original intention and mission of scientific researchers”, he hoped that the researchers will keep in mind the original intention and mission of “Serve the country and benefit the people by science and technology” and encouraged the researchers to promote the development of SCBG by joint effort.

Through special inspection and internal audit, the discipline inspection committee recovered 222,000 Yuan from funds violating regulations and 64,000 Yuan of questionable travel expenses.

Laid emphasis on culture of innovation and construction of United Front, Returned Overseas Chinese Federation and Mass organizations

SCBG vigorously promoted patriotism spirit and innovation culture by carrying out a series of activities, such as compiling the 90th anniversary anthology and album, shooting a promotional video, establishing a party construction theme, interviewing senior scientists for the column Oral History on the occasion of the celebration of 90th anniversary of SCBG.

Figure 4. The 90th anniversary anthology and album of SCBG

In 2019, ZHANG Fusheng was elected executive director of Guangzhou Overseas Returned Scholars Association; WANG Ying, HUANG Jianguo and other five scientific research backbones were identified as personages without party affiliation; SCBG branch of Chinese Peasants and Workers Democratic Party was reelected, and GONG Liang was elected the branch chairman.

Returned Overseas Chinese Federation visited seniors. SCBG’s Labor Union and Workers Congress have conducted public inquiry meeting, annual and regular working meeting and sport activities such as fun sports meeting, ball games, poker game, etc. The youth league committee has launched a series of academic activities aimed at young researchers. The party and administrative leadership visited and comforted 112 seniors in need on important holidays, a total of 68,400 Yuan of condolence payments and goods were distributed.

Figure 5. Participate in art performance held by Guangzhou Branch of CAS (September 27, 2019)

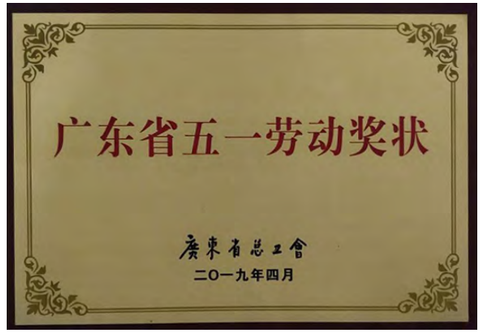


Figure 6. Dinghushan National Field Research Station of Forest Ecosystem won Guangdong May Day Labor Award

BGCI China Programme

Overview of BGCI work worldwide in 2019

During 2019, BGCI worked with the members of the Global Partnership for Plant Conservation (GPPC) to prepare a review of progress in implementing the 16 targets of the Global Strategy for Plant Conservation (GSPC 2011-2020). The report will be published in 2020 as a companion volume to the 5th edition of the *Global Biodiversity Outlook* (GBO). The Global Tree Assessment (GTA) has significantly increased their Red List assessment output in 2019, with 8,282 tree assessments published on the IUCN Red List of Threatened Species, four times the number published in 2018 and 93% of all IUCN global tree assessments published in 2019. In addition, BGCI has secured the funding to assess the conservation status of all trees (about 61,000) worldwide by 2020. At the action end of conservation, the unique international initiative of saving threatened tree species, Global Trees Campaign (GTC) celebrated its 20th anniversary in 2019, and has grown significantly since the early days, with 87 threatened tree species in 26 countries the focus of conservation efforts in 2019. More than 450,000 seedlings of threatened tree species were raised for conservation and restoration programs.

Figure 1.Chart of BGCI global program achievements

Figure 2. Group photo of BGCI staff

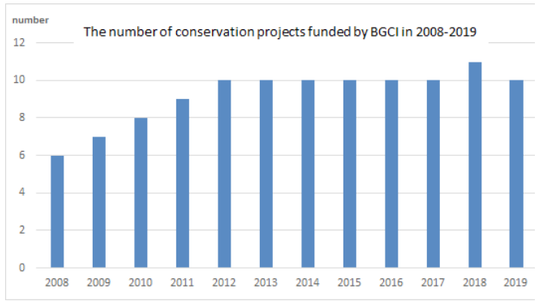
As part of BGCI’s work as an advocate for botanic gardens, and at the request of BGCI’s International Advisory Council (IAC), in 2019, BGCI produced a *Technical Review on the Role of Botanic Gardens in Urban Greening and Urban biodiversity Conservation*, two issues of *BGjournal* and *Roots*. In 2019, total 19 botanical gardens achieved BGCI Botanic Garden Accreditation and 13 botanical gardens achieved BGCI Advanced Conservation Practitioner Accreditation. BGCI supports botanic gardens through providing funding for plant conservation, public engagement and other important activities. In 2019, BGCI disbursed funds totaling 2,089,750 USD to botanic gardens and other institutions. While the vast majority of this funding came from BGCI-led projects, 2019 BGCI launched a brand new service for BGCI members – the Global Botanic Garden Fund (GBGF) to support small member botanical gardens especially to enhance their capacity of plant conservation. BGCI received 72 applications to the GBGF from 64 institutions in 39 countries, and gave out 17 grants in 2019.

In 2019, BGCI training courses were attended by 775 people from 331 institutions in 67 countries, with the topic of plant conservation policy and technique, as well as education. BGCI successfully organized about 50 meetings, symposia or workshops worldwide.

The progress of BGCI China Conservation projects

1. The scientific conservation model of BGCI practical conservation projects for threatened plant species is being gradually promoted throughout the country

Working with its Chinese botanical gardens members and partners to save endangered Chinese plants is the core mission of BGCI China Programme Office. To implement the GTC in China in 2019, BGCI funded about 170,000 USD for 10 practical conservation projects, secured 13 threatened tree species with more than 29,900 seedlings raised, through working with botanical gardens, forest departments, plant conservation organizations, as well as local communities. Since 2008, the scientific conservation model of threatened plants in China established and gradually improved by BGCI China office has been gradually promoted nationwide. That is, in collaboration with scientists from botanical gardens and other plant conservation agencies, and with the active participation of local communities, BGCI has applied an integrative conservation approach that combines ex-situ conservation, in-situ conservation and reintroduction of endangered plants, accompanied by a series of awareness raising workshops and capacity building trainings. In 2019, BGCI China training events were attended by 200 people from 25 institutions. In addition, more than 817 local villagers were trained on the techniques of propagation, cultivation, reintroduction, as well as harvesting. This accompanied the distribution of about 820 training materials. To raise awareness of plant conservation for local authorities, local people, and students, BGCI China office organized one stakeholder workshop with about 80 stakeholders attending/participating and held five educational activities in local kindergarten and primary schools for about 1,050 students, accompanied with the distribution of about 4,371 outreach materials and included 52 exhibition panels with the theme of threatened plants. The awareness and ability of plant conservation of stakeholders and students have been improved to a certain extent through those activities, and the local villagers have gained certain income from BGCI projects. WEN Xiangying, the head of BGCI China office was recommended as the deputy director of the Ex-situ Conservation Committee under China Wild Plants Conservation .



Association (CWPCA) for her personal contribution to plant conservation.

Figure 3. Map of BGCI conservation projects in 2019

Figure 4. Training local villagers on conservation techniques

Figure 5. Local villagers benefiting from BGCI projects

2. The organization of BGCI China Program Strategic Planning Workshop and Training

To improve threatened tree conservation planning, monitoring and evaluation, and enhance the ability of applying for funds from international organizations for our partners, BGCI China office successfully held BGCI China Program Strategic Planning Workshop and Training at Benxi city, Liaoning province in November, with about 50 participants including some of previous project partners, ongoing project partners, and potential project partners. During the workshop, the reintroduction of threatened species *Taxus cuspidata* was initiated with the involvement of all participants and 20 primary school students from Shenyang city. Liaoning TV and Shenyang TV interviewed Joachim Gratzfeld, the director of BGCI Regional Program, and reported those activities.

Figure 6. Group photo of BGCI China program training

3. Engaged in related policy and advocacy, as well as representing BGCI at relevant fora in China and abroad

Figure 7. WEN Xiangying discussing with her colleagues in BGCI Strategy Meeting

Figure 8. The cover of Chinese version of CSPC 2021-2030

As the largest national program of BGCI, its China office has been actively involved in the development of BGCI 2021-2025 Strategic Planning and attended two meetings held at BGCI Headquarter based at Kew, UK. The office was engaged in the review of the China's implementation of GSPC 2011-2020 and the development of the Chinese Strategy for Plant Conservation (CSPC 2021-2030). The review report of GSPC 2011-2020 was published at *Biological Conservation*. Led by this office, total 14 Chinese participants from six botanical gardens attended the 7th Southeast Asia Botanic Gardens Network Conference of BGCI at Queen Sirikit Botanic Garden, Chiangmai, Thailand, in August. During the conference, the head of BGCI China office introduced the Training and Study Opportunities provided by SCBG, Wuhan Botanical Garden and Xishuangbanna Tropical Botanical Garden of CAS for the countries along "One Belt and One Road". As one of the organizers, BGCI China office attended the GSPC world forum which was held at Dujiangyan city, Sichuan province in October, and shared one case study about the integrated conservation of threatened Chinese tree species funded by BGCI. Multiple media including CCTV and Guangming Daily Guangming Network interviewed Paul Smith, the secretary general of BGCI, about China's implementation of GSPC. Paul recognized China's great contribution to the implementation of GSPC and spoke highly of the leading role that China has played in plant conservation worldwide. The office was also invited to attend the annual meeting for International Organizations in environmental area in Beijing to learn about the management law of overseas NGOs so as to carry out activities reasonably and legally in China, and how to strengthen the further cooperation with related Chinese governments, which was organized by National Forestry and Grassland Administration. The China office was also actively involved in many other meetings related to plant conservation and botanical garden development and management and shared successful case studies in related aspects.

Figure 9. Group photo of Chinese delegation at 7th SEABGN meeting

Figure 10. Sharing of conservation project case study at GSPC international conference in 2019

4. The development of membership and its services

Besides maintaining existing 50 members including botanical gardens and other institutions, two new regular members and two new Patron Gardens (Beijing Botanical Garden and Hunan Forest Botanical Garden) were developed in 2019. To benefit Chinese members, some BGCI's resources were translated into Chinese. The translation of BGCI's *Manual* on *Planning, Developing and Managing Botanic Gardens* into Chinese was initiated in 2019 and would be finished in 2020. The translation of the briefs summarized by BGCI from the *Species Recovery Manual* published by BGCI and IABG in 2018 was finished in 2019 and the Chinese version was already uploaded into BGCI website for the download free of charge.

Biological Resources Programme of CAS

Biological resources refer to the sum of genes and species, including plants, animals, microorganisms, and human genetic resources, that have real and potential value to humans, and can be directly or indirectly used by humans in nature. Biological resources are the basic components of the ecosystem and the important material basis for human survival. They are important foundations for national economic development and ecological environmental protection.

The "12th Five-Year Plan" of CAS launched the Biological Resources Programme (BRP), which focus on serving social development and supporting scientific research. BRP integrates the Botanical Gardens, Biological Specimen Collections, Biological Genetic Resource Bank, Laboratory Animal Resources, and China Biodiversity Observation and Research Network of CAS to construct an integration resource system. On the basis of persisting in the long-term collection and preservation of biological resources, BRP aims to realize the analysis, evaluation and utilization of resources and promote the digitalization and informatization, and provide resource, talent and technical support for the completion of important scientific researches.

BRP has formed a "5+3+1" organizational structure, namely five resource collection and preservation platforms, three resource evaluation and transformation platforms, and one information center. Each resource collection and preservation platform has a working committee to provide guidance to the consisting units, and the three resource evaluation and transformation platforms are managed by the three lead units. Scientific advisory board and management board were established to provide guidance and management BRP. The office of Management Board, which in charge of the daily operation of Biological Resources Programme, the selection and progress evaluation for the leader of innovation project, and the annual performance evaluation of botanical gardens, biological specimen collections, biological genetic resources bank, laboratory animal resources and biodiversity observation and research network, and other things about BRP, has been attached to SCBG since 2016. At the same time, the office is also responsible for project application, management, project examination and acceptance of the innovation platform of plant germplasm resources led by SCBG.

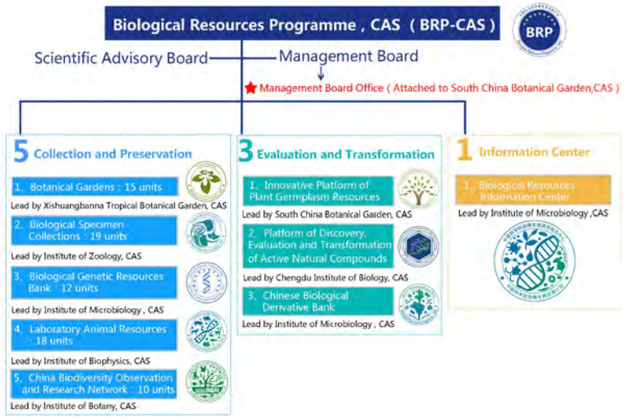


Figure 1. Organization structure of BRP

1. Compiled the 2018 annual reports of the five resource collection and preservation platforms

In April 2019, the management board office finished the data collection, typesetting, printing and publicity of the annual reports of the five collection and preservation platforms for the first time, with the content, format and cover pattern of the annual report unification. The general situation, the relevant data, and the work progress of botanical gardens, biological specimen collections, biological genetic resources bank, laboratory animal resources, and china biodiversity observation and research network of CAS, were introduced in detail. The annual reports are popularly accepted by the institutes of biological field, which effectively improved the publicity of BRP. At the same time, the electronic version of the annual reports was reprinted and quoted by several official accounts.

Figure 2. Annual reports of collection and preservation platforms of BRP

2. Organized the writing and publication of the article about biological resources in the *Bulletin of CAS*

In May 2019, SHAO Yunyun, the manager of the management board office, as the contributing editor of the special issue of the Bulletin, organized the heads of the collection and preservation platforms and the information center to write the articles about the protection and utilization of strategic biological resources and revised the manuscript carefully. In December, seven articles were published in the *Bulletin of CAS*, which comprehensively introduced the current situation and future development of the botanical gardens, biological specimen collections, and laboratory animal resources, the preservation and utilization of microorganism and cell resources, the overview of Chinese biodiversity observation network (Sino BON) and the big data and application of strategic biological resources in China.

Figure 3. BRP special articles on Bulletin of CAS

3. Compiled *BRP Observation*

BRP Observation is a thematic briefing on domestic and foreign scientific and technological developments in the biological resources field, which is organized by BRP. The briefing tracks and analyzes developments of biological resources and biodiversity at home and abroad in the biological field, and promotes the content and research progress of BRP. SHAO Yunyun participated in compiling the six issues of *BRP Observation* in 2019 and send them to the relevant platforms of CAS.

Figure 4. *BRP Observation*

4. Organized the 2019 annual meeting of BRP

The management board office and the Bureau of Science and Technology for Development jointly organized the 2019 annual meeting of BRP in Beijing. More than 60 people, including ZHANG Yaping, the vice president of CAS, members of the scientific advisory board, and management board, representatives of five working committee and relevant institutes, and experts from Department of Basic Research of the Ministry of Science and Technology of China, the National Facilities and Information Infrastructure for Science and Technology, the Department of Wildlife Conservation, National Forestry and Grassland Administration, and Chinese Research Academy of Environmental Sciences, were invited to the meeting. The representative of Biotechnology Division of the Bureau of Science and Technology for Development of CAS, reported the 2019 work summary and 2020 work plan of BRP. The heads of the five resource collection and preservation platforms, three evaluation and transformation platforms, and the information center reported the work progress and highlights in 2019. The invited leaders and experts at the meeting fully affirmed the overall construction effectiveness of BRP, praised the achievements in the construction of the national resource bank and national field stations, and highly evaluated the cooperation in biological resources between CAS and other national departments. At the meeting, experts from other departments put forward the hope to further strengthen cooperation with CAS in the areas of international compliance and species supervision.

Figure 5. 2019 Annual Meeting of BRP

5. Released *Catalogue of Biological Resources of the Chinese Academy of Sciences*

On December 9, 2019, the information center and the management board office officially released the *Catalogue of Biological Resources of the Chinese Academy of Sciences* on the symposium of the construction of biological resources information platform and its application, which was reported by Xinhuanet and People's Daily. This catalogue brings together more than seven million pieces of biological resource data from 76 biological resource banks of 40 institutes of CAS, including biological specimens, plant resources, biological genetic resources, laboratory animal resources, and biodiversity observation resources. The important achievements of CAS in the application of biological resources are introduced systematically. CAS has carried out long-term work on biological resources preservation and information construction, and formed a complete data system. At present, all biological resource data and related achievements are openly shared with the society through the

Figure 6. Writing program of biological resources in USB flash disk

Figure 7. Group photograph on releasing meeting

official website, which effectively promotes the integration and sharing of biological resource data and supports the national biological industry.

6. Managed and operated of the official website and official account of BRP

The management board office updated news on BRP official website (http://www.casbrc.org/home.jsp) and the official account (BRP CAS) throughout the year. The official website includes data of five resource collection and preservation platforms, three resource evaluation and transformation platforms, and achieves the systematic display and external publicity of the biological resources and services of CAS. It is a gateway system integrates CAS, the working committees and the institutes. In 2019, BRP official website established an integrated data management system for biological resource management and sharing based on unified standards, and formed a comprehensive catalogue covering all types of biological resources of CAS for the first time. Since the official account was opened on March 5, 2019, a total of 390 articles have been updated with four times a week on average and read more than 20,000 times.

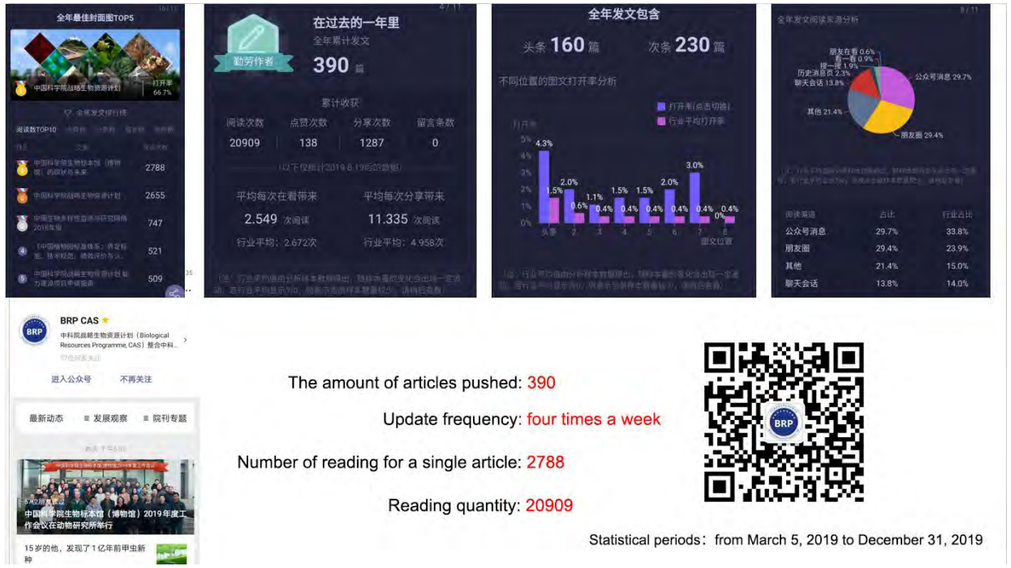


Figure 8. Relevant data of BRP official account

Key Laboratories

1. Key Laboratory of Plant Resources Conservation and Sustainable Utilization, CAS

The objectives of the laboratory are to meet the needs of national development strategy, focusing on the conservation and sustainable utilization of plant resources. Based on the multidisciplinary methods from gene and individual to population and community levels, the laboratory carries out both basic research and applied basic research in the following three fields: the mechanism of biodiversity formation and maintenance, the conservation and sustainable utilization of plant diversity as well as the utilization of germplasm, genetic and chemical resources. The laboratory also aims to provide theoretical and technological bases for the protection and sustainable utilization of important plant resources.

The director of the laboratory is Prof. JIANG Yueming and the deputy director is KANG Ming, while the director of the academic committee is Prof. HUANG Hongwen. At present, the laboratory has 102 researchers, including 27 professors. In 2019, three staff were promoted to associate professors.

In 2019, the laboratory has received 254 research projects with funds of 242 million Yuan. Among these projects, 29 were from Ministry of Science and Technology or National Natural Science Foundation of China, 13 were from CAS and 33 were from local government.

The laboratory has published 181 SCI papers, 49 of which were listed as top 30% and 19 were listed as top 10%. In addition, nine monographs have been published. The laboratory obtained 16 authorized invention patents, including one authorized US invention patent; and won the Outstanding Innovation Team Award of the Shennong China Agricultural Science and Technology as the second unit. The laboratory has 65 enrolled doctoral students and 87 enrolled master students; 19 doctoral students and 30 master students graduated in 2019; two students were awarded BIOMIGA Scholarship, three students won Pubang Garden Scholarship, and three students won the National Scholarship.

The 2019 Annual Meeting and Academic Committee of the Key Laboratory was successfully held in SCBG on December 4, 2019.

Figure 1. The annual meeting in 2019

2. Key Laboratory of Vegetation Restoration and Management of Degraded Ecosystems, CAS

The laboratory has mainly focused on the researches with respect to the structure, function and processes of different ecosystems, the mechanism of ecosystem degradation, and vegetation restoration of the degraded ecosystem in southern China.

The director of the laboratory is Prof. YE Qing and the deputy director is Prof. HUANG Jianguo, while the director of the academic committee is Prof. PENG Shaolin. At present, the laboratory has 70 researchers including 22 professors and 16 associate professors.

In total, there were 70 enrolled doctoral students and 90 enrolled master students in the laboratory, while six doctoral students and 22 master students graduated in 2019.

In 2019, the laboratory has received 76.16 million Yuan from 229 projects. In total, 79 new scientific research projects were granted in 2019, including six national projects, 17 projects were from National Natural Science Foundation of China, 29 projects were from CAS, seven projects were from Natural Science Foundation of Guangdong Province. There were 108 SCI papers have been published in international journals, 71 of which were published in top 30% journals of the related fields, and two national patents have been authorized in 2019.

Figure 2. Group photo of the annual meeting and academic seminar of the laboratory

Figure 3. The annual meeting and academic seminar in 2019

3. Key Laboratory of South China Agricultural Plant Molecular Analysis and Genetic Improvement, CAS

The objectives of the laboratory are to carry out basic theoretical research and technical development on molecular analysis and genetic improvement of agricultural plants in South China characteristics. For the seamless connection between breeding and application, the laboratory established close cooperation with enterprises, provided the cultivated varieties and promoted the healthy development of modern regional agriculture.

The director of the laboratory is Prof. WANG Ying and the deputy director is ZHANG Mingyong, while the director of the academic committee is Academician ZHANG Qifa. At present, the laboratory has 63 researchers, including 17 professors and 19 associate professor; there were 13 postdoctors in station, 38 enrolled doctoral students and 57 enrolled master students; eight doctoral students and 14 master students graduated in 2019.

In 2019, the laboratory received more than 25.54 million Yuan from 51 newly added research projects, and the total contract funds reached 138 million Yuan from 136 ongoing research projects. There were 78 SCI papers have been published in international journals, 23 of which were listed as top 10% and 32 were listed as top 30%. In addition, the laboratory obtained one international invention patent, 25 authorized national invention patents, 5 new varieties, and 18 new international varieties. The achievements of the project “Conservation, Germplasm Innovation and Key Industrialization Technologies of Orchid Plants with Distinct Chinese Characteristics” won the Second Prize of 2019 National Scientific and Technological Progress Award (SCBG as the third participant unit).

4. Key Laboratory of Digital Botanical Garden of Guangdong Province

The laboratory, which is the first key laboratory in China with the main research direction of digital botanical garden, was established in 2004.

Figure 4. The group photo of the academic committee

The main research directions of the laboratory include: digital botanical garden technology and integration, botanical garden scientific data sharing and co-construction, digital herbarium, virtual botanical garden, protection innovation and utilization of plant resources, ecological environmental resources monitoring. In October 2016, the laboratory passed the provincial key laboratory evaluation organized by the Department of Science and Technology of Guangdong Province and obtained a good grade.

The director of the laboratory is Prof. XIA Nianhe and the deputy director is ZHANG Zheng, while the director of the academic committee is Academician HONG Deyuan. At present, the laboratory has 60 researchers, including 16 professors and 26 associate professor. Seven doctoral students and 12 master students were graduated in 2019; one student won BIOMIGA Scholarship and the other won Pubang Garden Scholarship.

The laboratory has 75 added scientific research projects with fund more than 35.73 million Yuan. Among these projects, 20 were from National Natural Science Foundation of China, 11 were from CAS, 34 were from local government and 10 were from other sources. The laboratory has published 90 SCI papers and 10 monographs, obtained five authorized invention patents and two computer software copyright registrations in 2019.

On the base of deeply investigation on the routine work and needs of major botanical gardens in China, the investigators of laboratory completed the program development of “Plant information management system” (PIMS) and the APP (Android). At present, these works have obtained four computer software copyright registrations and have been used in 43 major botanical gardens in China. The widely use of the platform and the APP plays an important role in improving the level of data sharing and information management in botanical gardens in China.

5. Key Laboratory of Applied Botany of Guangdong Province

The laboratory was established in 2014. With the purpose of improving the efficiency of plant resource, the laboratory made great progresses in the following aspects: special plant resources conservation and germplasm innovation; functional elements research in special plants of China south region; environmental management and landscape optimization through botanical technologies.

The director of the laboratory is Prof. REN Hai, and the director of academic committee is Academician WU Weihua. At present, the laboratory has 139 researchers, including 46 professors. In 2019, there were 34 newly enrolled doctoral students and 74 master students; 26 doctoral students and 59 master students graduated.

In 2019, the laboratory has strived for 194 new scientific research projects. Among these projects, 56 were from National Natural Science Foundation of China or other national projects, 65 were from CAS, 59 were from local government. The funds from new projects reached 176.08 million Yuan, and funds in place reached 152.71 million Yuan. Totally 182 SCI papers have been published in international journals, the number hit a record high. In addition, six monographs have been published, 33 patent applications were submitted, 49 applications and 17 new cultivators were granted.

广东省学科类重点实验室评估
申请书
(2019年度)

实验室名称：	广东省应用植物学重点实验室
依托单位：	中国科学院华南植物园（盖章）
实验室主任：	任海
联 系 人：	陈峰
联系电话：	13701339862
传真电话：	020-37252837
E-mail地址：	chenfeng@scbg.ac.cn
通讯地址：	广州市天河区兴科路723号行政办公楼107室
邮政编码：	510650
主管部门：	中国科学院广州分院

广东省科学技术厅
2019年5月

Figure 5. Application for the assessment of key laboratory

Figure 6. Display board of the laboratory

Research Stations

1. Dinghushan National Field Research Station of Forest Ecosystem

Dinghushan National Field Research Station of Forest Ecosystem (hereafter referred to as Dinghushan station) is the member of the Chinese Ecosystem Research Network (CERN) and the Chinese National Ecosystem Research Network (CNERN). Dinghushan station is an excellent ecological field station which focuses on the national demands, the development of ecological system ecology and the frontier scientific issues, systematically studies the succession processes and natural course of the zonal forest ecosystem including structure and function, pattern-process relationships. The station is exploring the tropical and subtropical forest ecosystem, its responses, adaptations and mechanisms of key processes such as carbon, nitrogen, phosphorus, water cycle, and their coupling to global change. Dinghushan station, with its unique location advantages, well improved platform basement and abundant research accumulation, it has become an important ecological research station in China and abroad. It has offered scientific platforms for more than 10 institutes and universities for long term scientific researches, and also has given strong support to a batch of important projects, such as national key research and development projects, national natural science foundation projects, CAS strategic priority research projects and international cooperation projects, in terms of scientific research facilities, experimental equipment, observation data, background information, logistics support and personnel assistance.

Figure 1. The delegation of Jaramogi Oginga Odinga University of Science and Technology in Kenya investigated Dinghushan station

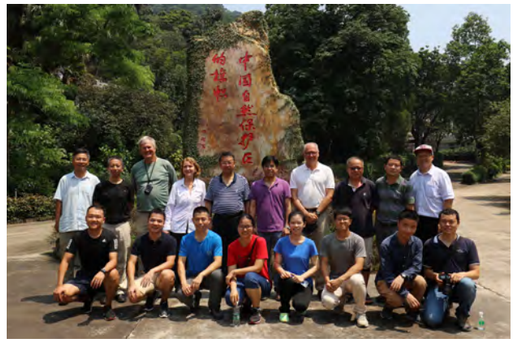


Figure 2.Peter Vitousek and Pamela Matson, the members of the United States National Academy of Sciences, investigated Dinghushan station

Figure 3. Group photo of international assessment experts with the personnel of Dinghushan station in the monsoon forest comprehensive observation field

At present, Dinghushan station has 19 scientific research staffs, five technical support staffs, nine postdoctoral researchers, nine project employees and more than 30 postgraduates. Six doctoral students and four master students graduated in 2019.

The station is equipped with a series of monitoring facilities including one meteorological automatic observation station, one forest climate observation tower in an evergreen monsoon forest, three forest water vapor flux observation towers in mixed conifer-broadleaf forests. There are many long-term experimental forest sites, such as one permanent

integrated experimental observation site, five permanent auxiliary observation sites. Along with these permanent sites, so far Dinghushan station has set up more than 50 various sites for long-term experiments (observations), such as forest ecosystems transplanted along an elevation gradient experimental site, simulated acid deposition experiment site, nitrogen addition experiment site, sap flow measurements site, providing researchers with perfect platform support for all kinds of ecological researches.

Dinghushan station is building a resource-sharing platform via website (http://dhf.cern.ac.cn/), which has provided about 100 offline data services, 60,000 online services and 15 GB data downloads for scientific researchers in 2019. Data users include international renowned academicians and other experts, scholars and students from many scientific research institutes at home and abroad.

In 2019, suppored by the infrastructure of Dinghushan station, 32 projects (including the launched and approved) were gained by researchers, among which, two were supported by National Science Fund for Distinguished Young Scholars, one were supported by International Cooperation Projects between National and International Funds, one were supported by National Science Foundation for Outstanding Youth, and two were funded by Youth Innovation Promotion Association of CAS. The total newly contracted scientific funds reached 24.9 million Yuan. In 2019, 60 papers have been published, among which, 42 papers (including 30 SCI papers and eight papers with Impact Factor over 5) with staffs of Dinghushan station as the first or corresponding author. The station obtained two authorized patents, three software copyright registrations and three new national authorized varieties. Guest researchers have published 17 papers (including seven SCI papers) and two monographs based on the researches in Dinghushan station. Both the quantity and quality of papers have reached a new record high in 2019.

Dinghushan station won Guangdong May Day Labor Award, and has been awarded excellent appraisal in the evaluation on the national public research platforms level of CNERN organized by the Ministry of Science and Technology.

Figure 4. The certificate of Guangdong May Day Labor Award

2. Heshan National Field Research Station of Forest Ecosystem

Heshan National Field Research Station of Forest Ecosystem (hereafter referred to as Heshan station) is the member station of the Chinese Ecosystem Research Network (CERN) and the Chinese National Ecosystem Research Network (CNERN). The station is located in the north of Jiangmen city, Guangdong Province and interlaced with the Pearl River Delta area with a dense population and rapid economic development. It represents the man-made and secondary evergreen broad-leaved forest ecosystems in the red earth hilly lands in the southern China provinces such as Guangdong, Guangxi, and Fujian. Long-term observational and experimental studies have been performed in Heshan station for nearly 35 years to understand the mechanisms of ecosystem degradation and restoration in lower subtropical China. Main research areas include ecological restoration, ecosystem management, global change ecology and soil ecology. At present, Heshan station has 16 researchers, including five professors, four associate professors, four research assistants and four technicians. There are seven long-term field experimental platforms open for domestic and foreign scholars to visit or carry out their researches.

In 2019, 27 research projects were carried out in Heshan Station, including one key project from the National Natural Science Foundation of China, one excellent youth project from the CAS, and one innovative talent project from the Ministry of Science and Technology, with total contract funds of 14.57 million Yuan. 11 research projects were finished in this year, while nine new projects were added, with additional contract funds of 2.21 million Yuan. There were 28 papers have been published in SCI journals, four of which with the impact factor over five. In addition, there were two patents have been authorized in 2019.

The total number of independent IP visits to the Heshan Data Sharing Website (http://hsf.cern.ac.cn) reached 15,006; the number of page views reached 75,299 with a data volume of 8.85 GB. The station laboratory provided sample test and analysis services for several domestic institutions, with a total of 46,000 data items. The station hosted more than 300 visitors and 10 investigation activities in 2019.

3. Xiaoliang Research Station of Tropical Coastal Ecosystem, CAS

Xiaoliang Research Station of Tropical Coastal Ecosystem, CAS (hereafter referred to as Xiaoliang station) is situated in Maoming city, Guangdong province. It targets at restoration of degraded land and remediation of contaminated paddy field, carbon sequestration in tropical coastal wetland.

The work of Xiaoliang station was progressing smoothly in 2019. The annual research fund was nearly 10 million Yuan, including fund from more than 10 national research projects and 20 CAS and local projects.

In 2019, the main members of Xiaoliang station participated in the Guangdong-Hong Kong-Macao Greater Bay Area Land Ecosystem Research Project of the Guangdong Marine Laboratory and would provide solutions to the ecological and environmental problems of the Greater Bay Area coastal zone. In addition, Xiaoliang station joined the Guangdong Forestry Field Ecological Monitoring Alliance, thereby the station will officially receive funding from the Guangdong Forestry Department since 2020 to coordinate the field monitoring work in Macau and Guangdong.

In 2019, researchers of the station have published 47 papers in various international academic journals, such as Nature Communications, Global Change Biology, and Functional Ecology. The research about coastal blue carbon, led by the deputy station manager WANG Faming, has been published in Nature Communications, which is an important breakthrough in the coastal research of the station in recent years, and shows the good development trend of the station in the coastal blue carbon. Xiaoliang station also achieved gratifying results in terms of technology promotion and application. The research team led by the station manager LI Zhian accurately assessed the nutrients lacking in coral

sand by comparing the composition of normal soil in the mainland. Based on this, the construction technology of coral sand vegetation was optimized, and two invention patents were declared, which can accurately provide coral sand supplements nutrients, and improve plant survival and growth rate. In addition, the research results on the mixed mode of shelterbelts in Maoming Coastal Zone also have been promoted and applied in the afforestation practice of the local forestry department.

Herbarium

1. The change of the growth mode of collections

In the past, the increase of collections was mainly based on field collection, but in the recent years, the number of specimens collected by exchange and sharing has been increased year by year. So far, more than 22,470 specimens were collected by sharing and exchange. And this work has been highly recognized by the Working Committee of CAS Herbarium.

Table 1. Annual sharing and exchange of specimens from 2016–2019

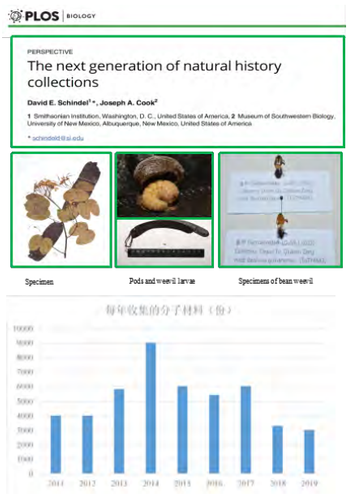
Year	New co-construction uints in the year	# of specimens exchanged and shared	% of exchanged and shared specimens in the total number of new collection in the year
2016	Guangdong Zinjin-Baixi Provincial Nature Reserve Fu-Guoai Herbarium of Hainan Forestry Bureau	6144	20%
2017	Guangdong Conhua-Chenhedong Provincial Nature Reserve Guangzhou Linfang Ecological Technology Co., Ltd Guizhou Dafu Environmental Technology Co., Ltd	5182	25%
2018	Herbarium of Guangdong Academy of Forestry	13515	55%
2019		4637	30%

2. Integrated specimen collection

Legumes are the traditional and important research group in SCBG. In 2018, the herbarium took the cultivation and collection of the parasitic insects of legumes and their seeds as an attempt, to gradually lead the innovative collection work of the herbaria in CAS. In 2019, good progress has been made in the study of the phylogeny of legumes and their parasitoids.

3. Molecular identification platform

In 2011, the herbarium took the lead in initiating the collection of DNA samples in CAS, which was highly recognized by the Working Committee of CAS Herbarium and was selected into the key tasks of the Herbarium Work. So far, more than 40,000 molecular materials have been collected. In 2019, the herbarium got the funding from CAS project, which will vigorously promote the construction of the platform.



Molecular materials collected annually from 2011-2019

Public Laboratory

In 2019, 32 sets of instruments in the public laboratory have provided analysis and testing services for the 351 subjects and 549 researchers. The average utilization rate of the instruments was 128% and the total sharing efficiency is 99%. The total effective working time was 65,782 hours and 134,106 samples were measured altogether.

In 2019, public laboratory presided five large instrument functional development projects of CAS, participated in one large instrument development project of CAS, and presided three open projects of Guangzhou Regional Center for Instruments Life Science, published seven papers, and obtained two authorized patent.

There were 73 persons participated in 30 various training or technical exchange activities, two certificates have been obtained. Public laboratory has organized 12 technical lectures or trainings for 480 persons and 10 certification management training on laboratory qualification for 54 persons. The revised qualification certification system has passed the flight inspection by Accreditation Committee in the end of 2019.

Figure 1. Technical training

Figure 2. Supervision and review

Public laboratory has successfully completed the CAS project of “Biological Resource Ecological Protection Experimental Platform” in 2018. The total value of critical instruments (“Liquid/gas Stable Isotope Mass Spectrometer” and “400M Solid Nuclear Magnetic Resonance Spectrometer”) in this project reached 7.7 million Yuan. The installation and debugging work has been completed, and the test operation of the instruments was normal.

Figure 3. The new instruments

Public laboratory also has successfully promoted the CAS project of “Biological Resources Microscopic Structure and Function Analysis Platform (Phase II)” in 2019, the budget of which was 4.5 million Yuan.

The investigation and bidding work to purchase the instrument “Frozen Microanalysis Field Emission Scanning Electron Microscope (SEM)” has been completed and the purchase contract has been signed. Currently, public laboratory is dealing with the formalities of foreign trade and the preliminary works of laboratory decoration to expect the smooth installation of the instrument.

The project of “Biological Molecules Structure and Functions Analysis Platform (Phase II)” with a total fund of four million Yuan will be added in 2020. It intends to purchase “Multifunctional Automatic Sample Preprocessing and Collection-Gas Chromatography-Olfactory-Triple Quadrupole Tandem Mass Spectrometer” and “Gas Chromatography-Single Quadrupole Mass Spectrometer”.

The public laboratory has successfully completed the purchase bidding of “3D Continuous Ultra-thin Slicer”, “Paraffin Slicer”, “Automatic Sample Processor”, “Inductively Coupled Plasma Emission Spectrometer” by the self-raised fund of 2.4 million Yuan, and now is handling the relevant foreign trade procedures, laboratory decoration, etc.

XU Xinlan, the director of the public laboratory, was appointed as the director of China Electronic Microscope Society and the deputy director of Agriculture and Forestry Committee of China Electronic Mirror Society, the vice chairman of Guangdong Electronic Mirror Society, the director of Guangdong Analytical Testing Society, and was the member of Tianhe District People’s Congress Standing Committee. By holding various social posts, she maximizes the visibility and influence of the public laboratory, and strives for more resources for SCBG. She also actively participated in the political discussion and served for community construction.

Director XU Xinlan won the Outstanding Individual Award of Public Technical Service Center of CAS (ranked first). The Molecular Structure and Function Analysis Platform won the Outstanding Platform Award of Guangzhou Large-scale Instrument Regional Center in 2019.

Supporting Center

Library

Resources Construction： In terms of electric resources construction in 2019, the library participated in the CAS group for purchasing 12 databases as usual. On this basis, we also independently purchased other online literature resources, such as eReading (a database of electric books). In addition, we added more than 1,000 papers to our “Chemical Database” by purchasing back issues of 12 chemical journals. Therefore, the expenses for buying electric resources increased considerably (Table 1).

Table 1. Expenses on literature construction since 2016 (Unit: Yuan)

	2016	2017		2018		2019	
	Expenditure	Expenditure	comparative growth on moving base%	Expenditure	comparative growth on moving base%	Expenditure	comparative growth on moving base%
Print copies	549,372.01	520,790.92	-5.20	462,077.99	-11.27	474,782.78	2.75
Electric resources	573,359.24	606,416.95	5.77	720,267.26	18.77	891,706.19	23.80
Subtotal	1,122,731.25	1,127,207.87	0.40	1,182,345.25	4.89	1,366,488.97	15.57

*Print copies including print books, and journals of print and online edition.

On the respect of print resources, printed copies were not subscribed when journals’ electric copies are available. Therefore, numbers of print journals decreased, and that of e-journals increased evidently. By browsing and searching on the webs, we bought print books of high relevancy to the research activity in SCBG. Table 2 shows the achievement of the library in purchase, catalogue, storage and delivery, etc.

Table 2. Table 2. 2019 Data on the construction of print publications

	Printed Books						Printed Periodicals				
	Language	Type	subtotal	Number	Subtotal	Cost(RMB)	Type	Subtotal	Volume	Subtotal	Cost (RMB)
purchase	Chinese	204	298	225	320	87,228	56	88	739	1110	245,790
	Foreign Language	94		95			32		371		
Donation/ exchange	Chinese	34	44	50	61	16,00*	67	97	352	410	
	Foreign Language	10		11			30		58		
Catalogued and Shelved	Chinese	215	270	249	305		Total Volumes of Journals Chinese 578		Chinese	Foreign Language	Total
	Foreign Languages	55		56					578	166	744

* The price of the donated books or journals were estimated by publisher suggested price or online purchasing price

Service works: In 2019, the library hosted 1,528 visitors, and provided service for over 870 readers on the webs. There were 565 person-times of readers, who checked out 972 books. And there were 572 person-times of readers, who returned 972 books. In the inter-library loan program, we borrowed over 189 books from other institutions. Through the QQ platform, E-mail or other interlibrary exchanges, we received 870 document claims by internal readers, the satisfaction rate reached 87.5%; and 45 claims by external readers, the satisfaction rate reached 80%. Within these transmitted documents, there were 100 thesis papers, two patents, and 71 books or various standards.

In terms of literatures indexing and citation, we successfully completed 36 reports for the researchers and graduate students of SCBG

Office of *Journal of Tropical and Subtropical Botany*

In 2019, we published *Journal of Tropical and Subtropical Botany*, Vol. 27 (issue 1-6). In total, 280 manuscripts were received and 92 papers with 1.56 million words altogether were selected for publication after peer review. Among the published papers, 91 were supported by research funds, accounting for 99% of the total, and 49 of which were supported by national funds.

According to "Chinese Academic Journal Comprehensive Citation Report Statistics", the journal has an impact factor of 0.787, with total 1,607 citations and 41,700 internet downloads.

Computer Network Center

With the support of Computer Network Information Center, the ARP system was upgraded to the new generation in August 2019. The new system provides good support and access to either computer client or cellphone client. Most business processes adopt online mode, which greatly improves work efficiency.

The network exit bandwidth and some network backbone equipment was upgraded and optimized in 2019, which will greatly improve users' experience of surfing the internet and effectively strengthen the network security protection. The cloud computing environment has added 120TB of storage space, 228 new CPU cores and 3.7TB of memory. Three new cloud servers have been opened to provide scientific computing services for researchers.

Appendix I. Main Papers

Sorted in descending order by impact factors

No.	Title	Journal Name	Issue Volume	Start	Stop	Impact Factor	Authors
1	Ancient polymorphisms contribute to genome-wide variation by long-term balancing selection and divergent sorting in Boechera stricta	GENOME BIOLOGY	20	161		14.028	Wang BS*, Mojica JP, Perera N, Lee CR, Lovell JT, Sharma A, Adam C, Lipzen A, Barry K, Rokhsar DS, Schmutz J, Mitchell-Olds T
2	Climate and litter C/N ratio constrain soil organic carbon accumulation	NATIONAL SCIENCE REVIEW	6	746	757	13.222	Zhou GY*, Xu S, Ciais P, Manzoni S, Fang JY, Yu GR, Tang XL, Zhou P, Wang WT, Yan JH, Wang GX, Ma KP, Li SG, Du S, Han SJ, Ma YX, Zhang DQ, Liu JX, Liu SZ, Chu GW, Zhang QM, Li YL, Huang WJ, Ren H, Lu XK, Chen XZ
3	Hydraulic traits are coordinated with maximum plant height at the global scale	SCIENCE ADVANCES	5	eaav 1332		12.804	Liu H, Gleason SM, Hao GY, Hua L, He PC, Goldstein G, Ye Q*
4	Tidal wetland resilience to sea level rise increases their carbon sequestration capacity in United States	NATURE COMMUNICATION	10	5434		11.878	Wang FM, Lu XL, Sanders CJ,Tang JW*
5	DELLA and EDS1 Form a Feedback Regulatory Module to Fine-Tune Plant Growth-Defense Tradeoff in Arabidopsis	MOLECULAR PLANT	12	1485	1498	10.812	Li YG, Yang YH, Hu YL, Liu HL, He M, Yang ZY, Kong FJ, Liu X, Hou XL*
6	Natural Estrogen Receptor Modulators and Their Heterologous Biosynthesis	TRENDS IN ENDOCRINOLOGY AND METABOLISM	30	66	76	9.777	Yang JL, Wen LR, Jiang YM, Yang B*
7	Long-term changes in the impacts of global warming on leaf phenology of four temperate tree species	GLOBAL CHANGE BIOLOGY	25	997	1004	8.880	Chen L, Huang JG*, Ma QQ, Hanninen H, Tremblay F, Bergeron Y
8	Divergent trends in the risk of spring frost damage to trees in Europe with recent warming	GLOBAL CHANGE BIOLOGY	25	351	360	8.880	Ma QQ, Huang JG*, Hanninen H, Berninger F
9	Global pattern and controls of biological nitrogen fixation under nutrient enrichment: A meta-analysis	GLOBAL CHANGE BIOLOGY	25	3018	3030	8.880	Zheng MH, Zhou ZH, Luo YQ, Zhao P, Mo JM*
10	Long-term nitrogen addition modifies microbial composition and functions for slow carbon cycling and increased sequestration in tropical forest soil	GLOBAL CHANGE BIOLOGY	25	3267	3281	8.880	Tian J, Dungait JAJ, Lu XK, Yang YF, Hartley IP, Zhang W, Mo JM*, Yu GR*, Zhou JZ, Kuzyakov Y

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11	Leaf mechanical strength and photosynthetic capacity vary independently across 57 subtropical forest species with contrasting light requirements	NEW PHYTOLOGIST	223	607	618	7.299	He PC, Wright IJ, Zhu SD, Onoda Y, Liu H, Li RH, Liu XR, Hua L, Oyanoghafo OO, Ye Q*
12	Replacement of stacked transgenes in planta	PLANT BIOTECHNOLOGY JOURNAL	17	2029	2031	6.840	Chen WQ, Kaur G, Hou LL, Li RY, Ow DW*
13	Understanding the biosyntheses and stress response mechanisms of aroma compounds in tea (Camellia sinensis) to safely and effectively improve tea aroma	CRITICAL REVIEWS IN FOOD SCIENCE AND NUTRITION	59	2321	2334	6.704	Zeng LT, Watanabe N, Yang ZY*
14	Cytorhizins A-D, Four Highly Structure-Combined Benzophenones from the Endophytic Fungus Cytospora rhizophorae	ORGANIC LETTERS	21	1063	1067	6.555	Liu HX, Tan HB, Chen YC, Guo XY, Wang WX, Guo H, Liu ZM, Zhang WM*
15	GATA and Phytochrome Interacting Factor Transcription Factors Regulate Light-Induced Vindoline Biosynthesis in Catharanthus roseus	PLANT PHYSIOLOGY	180	1336	1350	6.305	Liu YL, Patra B, Pattanaik S, Wang Y, Yuan L*
16	HY5 Interacts with the Histone Deacetylase HDA15 to Repress Hypocotyl Cell Elongation in Photomorphogenesis	PLANT PHYSIOLOGY	180	1450	1466	6.305	Zhao LM, Peng T, Chen CY, Ji RJ, Gu DC, Li TT, Zhang DD, Tu YS, Wu KQ, Liu XC*
17	The Calmodulin-Binding Protein IQM1 Interacts with CATALASE2 to Affect Pathogen Defense	PLANT PHYSIOLOGY	181	1314	1327	6.305	Lv T, Li XM, Fan T, Luo H, Xie C, Zhou Y, Tian CE*
18	Multiple parapatric pollinators have radiated across a continental fig tree displaying clinal genetic variation	MOLECULAR ECOLOGY	28	2391	2405	5.855	Yu H*, Tian EW, Zheng LN, Deng XX, Cheng YF, Chen LF, Wu W, Tanming W, Zhang DY, Compton SG, Kjellberg F
19	beta-Aminobutyric Acid Priming Acquisition and Defense Response of Mango Fruit to Colletotrichum gloeosporioides Infection Based on Quantitative Proteomics	CELLS	8	1029		5.656	Li TT, Fan PH, Yun Z, Jiang GX, Zhang ZK*, Jiang YM
20	Cross-Kingdom Small RNAs among Animals, Plants and Microbes	CELLS	8	371		5.656	Zeng J, Gupta VK, Jiang YM, Yang B, Gong L*, Zhu H*
21	Effects of urbanization on plant phosphorus availability in broadleaf and needleleaf subtropical forests	SCIENCE OF THE TOTAL ENVIRONMENT	684	50	57	5.589	Huang J, Liu JX, Zhang W, Cai XA, Liu L, Zheng MH*, Mo JM*
22	Effects of elevated atmospheric CO2 and nitrogen deposition on leaf litter and soil carbon degrading enzyme activities in a Cd-contaminated environment: A mesocosm study	SCIENCE OF THE TOTAL ENVIRONMENT	671	157	164	5.589	Luo XZ, Hou EQ, Zang XW, Zhang LL, Yi YF, Wen DZ*
23	Effects of forest conversion on carbon-degrading enzyme activities in subtropical China	SCIENCE OF THE TOTAL ENVIRONMENT	696	133968		5.589	Luo XZ, Hou EQ, Zhang LL, Zang XW, Yi YF, Zhang GH, Wen DZ*
24	Phosphate addition diminishes the efficacy of wollastonite in decreasing Cd uptake by rice (Oryza sativa L.) in paddy soil	SCIENCE OF THE TOTAL ENVIRONMENT	687	441	450	5.589	Mao P, Zhuang P, Li F, McBride MB, Ren WD, Li YX, Li YW, Mo H, Fu HY, Li ZA*
25	Responses of sap flux and intrinsic water use efficiency to canopy and understory nitrogen addition in a temperate broadleaved deciduous forest	SCIENCE OF THE TOTAL ENVIRONMENT	648	325	336	5.589	Hu YT, Zhao P*, Zhu LW, Zhao XH, Ni GY, Ouyang L, Schafer KVR, Shen WJ
26	Emergy-based analysis of the energy security of China	ENERGY	181	123	135	5.537	Lu HF, Xu FY, Liu HX, Wang J, Campbell DE, Ren H*
27	Identification of an immunostimulatory polysaccharide in banana	FOOD CHEMISTRY	277	46	53	5.399	Yang JL, Tu JM, Liu HL, Wen LR, Jiang YM, Yang B*
28	Effect of morin on the degradation of water-soluble polysaccharides in banana during softening	FOOD CHEMISTRY	287	346	353	5.399	Yang JL, Zeng J, Wen LR, Zhu H, Jiang YM, John A, Yu LM, Yang B*
29	Characterization of enzymes specifically producing chiral flavor compounds (R)- and (S)-1-phenylethanol from tea (Camellia sinensis) flowers	FOOD CHEMISTRY	280	27	33	5.399	Zhou Y, Peng QY, Zhang L, Cheng SH, Zeng LT, Dong F, Yang ZY*
30	Visualized analysis of within-tissue spatial distribution of specialized metabolites in tea (Camellia sinensis) using desorption electrospray ionization imaging mass spectrometry	FOOD CHEMISTRY	292	204	210	5.399	Liao YY, Fu XM, Zhou HY, Rao W, Zeng LT, Yang ZY*
31	Adsorption isotherm studies on the interaction between polyphenols and apple cell walls: Effects of variety, heating and drying	FOOD CHEMISTRY	282	58	66	5.399	Liu DJ, Lopez-Sanchez P, Martinez-Sanz M, Gilbert EP, Gidley MJ*
32	Sodium para-aminosalicylate delays pericarp browning of litchi fruit by inhibiting ROS-mediated senescence during postharvest storage	FOOD CHEMISTRY	278	552	559	5.399	Li TT*, Shi DD, Wu QX, Zhang ZK, Qu HX, Jiang YM
33	An alternative pathway for the formation of aromatic aroma compounds derived from L-phenylalanine via phenylpyruvic acid in tea (Camellia sinensis (L.) O. Kuntze) leaves	FOOD CHEMISTRY	270	17	24	5.399	Wang XQ, Zeng LT, Liao YY, Zhou Y, Xu XL, Dong F, Yang ZY*
34	Lycopene cyclases determine high alpha-/beta-carotene ratio and increased carotenoids in bananas ripening at high temperatures	FOOD CHEMISTRY	283	131	140	5.399	Fu XM, Cheng SH, Feng C, Kang M, Huang BZ, Jiang YM, Duan XW, Grierson D, Yang ZY*
35	Differential accumulation of specialized metabolite L-theanine in green and albino-induced yellow tea (Camellia sinensis) leaves	FOOD CHEMISTRY	276	93	100	5.399	Cheng SH, Fu XM, Liao YY, Xu XL, Zeng LT, Tang JC, Li JL, Lai JH, Yang ZY*
36	Life history is a key factor explaining functional trait diversity among subtropical grasses, and its influence differs between C-3 and C-4 species	JOURNAL OF EXPERIMENTAL BOTANY	70	1567	1580	5.360	Liu H, Taylor SH, Xu QY, Lin YX, Hou H, Wu GL, Ye Q*

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37	Distinct responses of soil fungal and bacterial nitrate immobilization to land conversion from forest to agriculture	SOIL BIOLOGY & BIOCHEMISTRY	134	81	89	5.290	Li XB, He HB, Zhang XD, Yan XY, Six J, Cai ZC, Barthel M, Zhang JB, Necpalova M, Ma QQ, Li ZA*
38	Soil moisture drives microbial controls on carbon decomposition in two subtropical forests	SOIL BIOLOGY & BIOCHEMISTRY	130	185	194	5.290	Wang GS*, Huang WJ, Mayes MA, Liu XD, Zhang DQ, Zhang QM, Han TF, Zhou GY*
39	Cytorhizophins A and B, benzophenone-hemiterpene adducts from the endophytic fungus Cytospora rhizophorae	ORGANIC CHEMISTRY FRONTIERS	6	591	596	5.076	Liu HX, Tan HB, Wang WX, Zhang WG, Chen YC, Li SN, Liu ZM, Li HH, Zhang WM*
40	Foliar phosphorus fractions reveal how tropical plants maintain photosynthetic rates despite low soil phosphorus availability	FUNCTIONAL ECOLOGY	33	503	513	5.037	Mo QF, Li ZA, Sayer EJ, Lambers H, Li YW, Zou B, Tang JW, Heskel M, Ding YZ, Wang FM*
41	Fine root dynamics responses to nitrogen addition depend on root order, soil layer, and experimental duration in a subtropical forest	BIOLOGY AND FERTILITY OF SOILS	55	723	736	4.829	Wang WJ, Mo QF, Han XG, Hui DF, Shen WJ*
42	Warming changes soil N and P supplies in model tropical forests	BIOLOGY AND FERTILITY OF SOILS	55	751	763	4.829	Lie ZY, Lin W, Huang WJ, Fang X, Huang CM, Wu T, Chu GW, Liu SZ, Meng Z, Zhou GY, Liu JX*
43	Characterization of Terpene Synthase from Tea Green Leafhopper Being Involved in Formation of Geraniol in Tea (Camellia sinensis) Leaves and Potential Effect of Geraniol on Insect-Derived Endobacteria	BIOMOLECULES	9	808		4.694	Zhou Y, Liu XY, Yang ZY*
44	Integrated Transcriptomic, Proteomic, and Metabolomics Analysis Reveals Peel Ripening of Harvested Banana under Natural Condition	BIOMOLECULES	9	167		4.694	Yun Z, Li TT, Gao HJ, Zhu H, Gupta VK, Jiang YM, Duan XW*
45	Combination of Transcriptomic, Proteomic, and Metabolomic Analysis Reveals the Ripening Mechanism of Banana Pulp	BIOMOLECULES	9	523		4.694	Li TT, Yun Z, Wu QX, Qu HX, Duan XW*, Jiang YM
46	Mechanism of Cell Wall Polysaccharides Modification in Harvested ”Shatangju’ Mandarin (Citrus reticulate Blanco) Fruit Caused by Penicillium italicum	BIOMOLECULES	9	160		4.694	Li TT*, Shi DD, Wu QX, Yin CX, Li FJ, Shan YX, Duan XW, Jiang YM*
47	Secretome Profiling Reveals Virulence-Associated Proteins of Fusarium proliferatum during Interaction with Banana Fruit	BIOMOLECULES	9	246		4.694	Li TT, Wu Y, Wang Y, Gao HY, Gupta VK*, Duan XW, Qu HX, Jiang YM*
48	LcNAC13 Physically Interacts with LcR1MYB1 to Coregulate Anthocyanin Biosynthesis-Related Genes during Litchi Fruit Ripening	BIOMOLECULES	9	135		4.694	Jiang GX, Li ZW, Song YB, Zhu H, Lin S, Huang RM, Jiang YM, Duan XW*
49	Cytosporone B as a Biological Preservative: Purification, Fungicidal Activity and Mechanism of Action against Geotrichum citri-aurantii	BIOMOLECULES	9	125		4.694	Yin CX, Liu HX, Shan Y, Gupta VK*, Jiang YM, Zhang WM*, Tan HB, Gong L*
50	Changes in Metabolisms of Antioxidant and Cell Wall in Three Pummelo Cultivars during Postharvest Storage	BIOMOLECULES	9	319		4.694	Liu J*, Liang L, Jiang YM*, Chen JJ
51	The Inhibitory Effects of Nitrogen Deposition on Asymbiotic Nitrogen Fixation are Divergent Between a Tropical and a Temperate Forest	ECOSYSTEMS	22	955	967	4.555	Zheng MH, Zhang W*, Luo YQ, Wan SQ, Fu SL, Wang SH, Liu N, Ye Q, Yan JH, Zou B, Fang CL, Ju YX, Ha DL, Zhu LW, Mo JM*
52	Effects of canopy and understory nitrogen addition on the structure and eco-exergy of a subtropical forest community	ECOLOGICAL INDICATORS	106	UNSP 105459		4.490	Tian Y, Lu HF*, Wang J, Lin YB, Campbell DE, Jian SG*
53	Changes in plant functional traits and their relationships with environmental factors along an urban-rural gradient in Guangzhou, China	ECOLOGICAL INDICATORS	106	UNSP 105558		4.490	Song GM, Wang J, Han TT, Wang Q, Ren H*, Zhu HX, Wen XY, Hui DF
54	Are reproductive traits of dominant species associated with specific resource allocation strategies during forest succession in southern China?	ECOLOGICAL INDICATORS	102	538	546	4.490	Han TT, Lu HF, Ren H*, Wang J, Song GM, Hui DF, Guo QF, Zhu SD
55	Progress of implementation on the Global Strategy for Plant Conservation in (2011-2020) China	BIOLOGICAL CONSERVATION	230	169	178	4.451	Ren H*, Qin HN, Ouyang ZY, Wen XY, Jin XH, Liu H, Lu HF, Liu HX, Zhou J, Zeng Y, Smith P, Jackson PW, Gratzfeld J, Sharrock S, Xu HG, Zhang ZX, Guo QF, Sun WB, Ma JS, Hu YH, Zhang QM, Zhao LN
56	Leaf and Root Endospheres Harbor Lower Fungal Diversity and Less Complex Fungal Co-occurrence Patterns Than Rhizosphere	FRONTIERS IN MICROBIOLOGY	10	1015		4.259	Qian X, Li HZ, Wang YL, Wu BW, Wu MS, Chen L, Li XC, Zhang Y, Wang XP, Shi MM, Zheng Y*, Guo LD, Zhang DX*
57	Perspectives on Endosymbiosis in Coralloid Roots: Association of Cycads and Cyanobacteria	FRONTIERS IN MICROBIOLOGY	10	1888		4.259	Chang ACG, Chen T, Lie N*, Duan J*
58	Warming but Not Nitrogen Addition Alters the Linear Relationship Between Microbial Respiration and Biomass	FRONTIERS IN MICROBIOLOGY	10	1055		4.259	Wei H, Chen XM, He JH, Huang LT, Shen WJ*
59	Diurnal Temperature Variation and Plants Drive Latitudinal Patterns in Seasonal Dynamics of Soil Microbial Community	FRONTIERS IN MICROBIOLOGY	10	674		4.259	Hu A, Nie YX, Yu GR, Han CH, He JH, He NP, Liu SR, Deng J, Shen WH, Zhang GX*
60	Callistemonols A and B, Potent Antimicrobial Acylphloroglucinol Derivatives with Unusual Carbon Skeletons from Callistemon viminalis	JOURNAL OF NATURAL PRODUCTS	82	1917	1922	4.257	Wu JW, Li BL, Tang CP, Ke CQ, Zhu NL, Qiu SX*, Ye Y*

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61	Contributions of competition and climate on radial growth of Pinus massoniana in subtropics of China	AGRICULTURAL AND FOREST METEOROLOGY	274	7	17	4.189	Liang HX, Huang JG*, Ma QQ, Li JY, Wang Z, Guo XL, Zhu HX, Jiang SW, Zhou P, Yu BY, Luo DW
62	Precipitation has dominant influences on the variation of plant hydraulics of the native Castanopsis fargesii (Fagaceae) in subtropical China	AGRICULTURAL AND FOREST METEOROLOGY	271	83	91	4.189	Liang XY, He PC, Liu H, Zhu SD, Uyehara IK, Hou H, Wu GL, Zhang H, You ZT, Xiao YY, Ye Q*
63	A stomatal optimization approach improves the estimation of carbon assimilation from sap flow measurements	AGRICULTURAL AND FOREST METEOROLOGY	279	107735		4.189	Hu YT, Duman T, Vaderklein D, Zhao P, Schäfer KVR*
64	Contrasting drought sensitivity and post-drought resilience among three co-occurring tree species in subtropical China	AGRICULTURAL AND FOREST METEOROLOGY	272	55	68	4.189	Duan HL, Li YY, Xu Y, Zhou SX, Liu J, Tissue DT, Liu JX*
65	Roles of the INO80 and SWR1 Chromatin Remodeling Complexes in Plants	INTERNATIONAL JOURNAL OF MOLECULAR SCIENCES	20	4591		4.183	Wang JH, Gao SJ, Peng XL, Wu KQ*, Yang SG*
66	Formation of alpha-Farnesene in Tea (Camellia sinensis) Leaves Induced by Herbivore-Derived Wounding and Its Effect on Neighboring Tea Plants	INTERNATIONAL JOURNAL OF MOLECULAR SCIENCES	20			4.183	Wang XW, Zeng LT, Liao YY, Li JL, Tang JC, Yang ZY*
67	Chloroplast Genomes and Comparative Analyses among Thirteen Taxa within Myrsinaceae s.str. Clade (Myrsinoideae, Primulaceae)	INTERNATIONAL JOURNAL OF MOLECULAR SCIENCES	20	4534		4.183	Yan XK, Liu TJ, Yuan X, Xu Y, Yan HF*, Hao G*
68	Identification and Characterization of Tomato SWI3-Like Proteins: Overexpression of SlSWIC Increases the Leaf Size in Transgenic Arabidopsis	INTERNATIONAL JOURNAL OF MOLECULAR SCIENCES	20	5121		4.183	Zhao ZY, Li T,Peng XL,Wu KQ*, Yang SG*
69	Dating Whole Genome Duplication in Ceratopteris thalictroides and Potential Adaptive Values of Retained Gene Duplicates	INTERNATIONAL JOURNAL OF MOLECULAR SCIENCES	20	1926		4.183	Zhang R, Wang FG, Zhang J, Shang H, Liu L, Wang H, Zhao GH, Shen H, Yan YH*
70	Genome-Wide Characterization, Expression Profile Analysis of WRKY Family Genes in Santalum album and Functional Identification of Their Role in Abiotic Stress	INTERNATIONAL JOURNAL OF MOLECULAR SCIENCES	20	5676		4.183	Yan HF, Li MZ, Xiong YP, Wu JM*, da Silva JAT*, Ma GH*
71	Influence of Chloroplast Defects on Formation of Jasmonic Acid and Characteristic Aroma Compounds in Tea (Camellia sinensis) Leaves Exposed to Postharvest Stresses	INTERNATIONAL JOURNAL OF MOLECULAR SCIENCES	20	1044		4.183	Li JL, Zeng LT, Liao YY, Gu DC, Tang JC*, Yang ZY*
72	Arabidopsis Histone Methyltransferase SUVH5 Is a Positive Regulator of Light-Mediated Seed Germination	FRONTIERS IN PLANT SCIENCE	10	841		4.106	Gu DC, Ji RJ, He CM, Peng T, Zhang MY, Duan J, Xiong CY*, Liu XC*
73	The Complete Chloroplast Genomes of Echinacanthus Species (Acanthaceae): Phylogenetic Relationships, Adaptive Evolution, and Screening of Molecular Markers	FRONTIERS IN PLANT SCIENCE	9	1989		4.106	Gao CM, Deng YF*, Wang J
74	Testing the competition-colonization trade-off and its correlations with functional trait variations among subtropical tree species	SCIENTIFIC REPORTS	9	14942		4.011	Bin Y, Lin GJ, Russo SE, Huang ZL, Shen Y, Cao HL, Lian JY, Ye WH*
75	Isolation and characterization of an atypical LEA gene (IpLEA) from Ipomoea pes-caprae conferring salt/drought and oxidative stress tolerance	SCIENTIFIC REPORTS	9	14838		4.011	Zheng JX, Su HX, Lin RY, Zhang H, Xia KF, Jian SG, Zhang M*
76	Mining MYB transcription factors from the genomes of orchids (Phalaenopsis and Dendrobium) and characterization of an orchid R2R3-MYB gene involved in water-soluble polysaccharide biosynthesis	SCIENTIFIC REPORTS	9	13818		4.011	He CM, da Silva JATE, Wang HB, Si C, Zhang MZ, Zhang XM, Li MZ, Tan JW, Duan J*
77	Different species or genetically divergent populations? Integrative species delimitation of the Primulina hochiensis complex from isolated karst habitats	MOLECULAR PHYLOGENETICS AND EVOLUTION	132	219	231	3.992	Yang LH, Kong HH, Huang JP, Kang M*
78	Nuclear loci developed from multiple transcriptomes yield high resolution in phylogeny of scaly tree ferns (Cyatheaceae) from China and Vietnam	MOLECULAR PHYLOGENETICS AND EVOLUTION	139	106567		3.992	Dong SY, Xiao Y, Kong HH, Feng C, Harris AJ, Yan YH, Kang M*
79	Evolution of CYCLOIDEA-like genes in Fabales: Insights into duplication patterns and the control of floral symmetry	MOLECULAR PHYLOGENETICS AND EVOLUTION	132	81	89	3.992	Zhao ZT, Hu J, Chen S, Luo ZL, Luo D, Wen J, Tu TY*, Zhang DX
80	Phylogeny, origin and dispersal of Saussurea (Asteraceae) based on chloroplast genome data	MOLECULAR PHYLOGENETICS AND EVOLUTION	141	106613		3.992	Xu LS, Herrando-Moraira S, Susanna A, Galbany-Casals M, Chen YS*
81	The simulated N deposition accelerates net N mineralization and nitrification in a tropical forest soil	BIOGEOSCIENCES	16	4277	4291	3.951	Nie YX, Han XG, Chen J, Wang MC, Shen WJ*
82	Determination of H+ and Ca2+ fluxes in cold-stored banana fruit using non-invasive micro-test technology	POSTHARVEST BIOLOGY AND TECHNOLOGY	153	169	175	3.927	Liu J, Li FJ, Shan YX, Zhou YJ, Liang L, Qu HX*, Jiang YM*, Chen JJ
83	Genome-wide identification, characterization and expression analysis of NF-Y gene family in relation to fruit ripening in banana	POSTHARVEST BIOLOGY AND TECHNOLOGY	151	98	110	3.927	Yan HL, Wu FW, Jiang GX, Xiao L, Li ZW, Duan XW*, Jiang YM
84	Synergistic interaction of natamycin with carboxymethyl chitosan for controlling Alternata alternara, a cause of black spot rot in postharvest jujube fruit	POSTHARVEST BIOLOGY AND TECHNOLOGY	156	UNSP 110919		3.927	Gong L, Zhao ZY, Yin CX, Gupta VK, Zhang XH*, Jiang YM

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85	1-Methylcyclopropene (1-MCP) slows ripening of kiwifruit and affects energy status, membrane fatty acid contents and cell membrane integrity	POSTHARVEST BIOLOGY AND TECHNOLOGY	156	UNSP 110941		3.927	Huang H*, Guo LF, Wang L, Wang H, Ma SM, Jiang YM, Qu HX*
86	Comparative profiling of primary metabolites and volatile compounds in Satsuma mandarin peel after ozone treatment	POSTHARVEST BIOLOGY AND TECHNOLOGY	153	1	12	3.927	Wu QX, Zhu XR, Gao HJ, Zhang ZK, Zhu H, Duan XW, Qu HX, Yun Z*, Jiang YM
87	Influence of low temperature on physiology and bioactivity of postharvest Dendrobium officinale stems	POSTHARVEST BIOLOGY AND TECHNOLOGY	148	97	106	3.927	Yu ZM, Yang ZY, da Silva JAT, Luo JP, Duan J*
88	Increasing postharvest high-temperatures lead to increased volatile phenylpropanoids/benzenoids accumulation in cut rose (Rosa hybrida) flowers	POSTHARVEST BIOLOGY AND TECHNOLOGY	148	68	75	3.927	Zeng LT, Wang XQ, Dong F, Watanabe N, Yang ZY*
89	Formation of and changes in phytohormone levels in response to stress during the manufacturing process of oolong tea (Camellia sinensis)	POSTHARVEST BIOLOGY AND TECHNOLOGY	157	UNSP 110974		3.927	Zeng LT, Wang XW, Liao YY, Gu DC, Dong F, Yang ZY*
90	Effects of Different Carbon Sources on Fumonisin Production and FUM Gene Expression by Fusarium proliferatum	TOXINS	11	289		3.895	Wu Y, Li TT, Gong L, Wang Y, Jiang YM*
91	(2679) Proposal to conserve the name Talauma fistulosa (Lirianthe fistulosa, Magnolia fistulosa) (Magnoliaceae) with a conserved type	TAXON	68	405	406	3.823	Deng YF*
92	(74) Request for a binding decision on whether the names Aspidium stenopteris Kunze (Nephrodium stenopteris (Kunze) DC Eaton) (Thelypteridaceae) and N. stenopteron Baker (A. stenopteron (Baker) Christ) (Tectariaceae) are sufficiently alike to be confused	TAXON	68	173	173	3.823	Dong SY*, Deng YF
93	The role of endogenous thiamine produced via THIC in root nodule symbiosis in Lotus japonicus	PLANT SCIENCE	283	311	320	3.785	Yin YH, Tian L, Li XL, Huang MC, Liu LR, Wu PZ, Li MR, Jiang HW, Wu GJ, Chen YP*
94	The beta-1,3-galactosetransferase gene DoGALT2 is essential for stigmatic mucilage production in Dendrobium officinale	PLANT SCIENCE	287	110179		3.785	Yu ZM, Zhang GH, da Silva JAT, Yang ZY, Duan J*
95	Identification of moracin N in mulberry leaf and evaluation of antioxidant activity	FOOD AND CHEMICAL TOXICOLOGY	132	110730		3.775	Tu JM, Shi DD, Wen LR, Jiang YM, Zhao YP, Yang JL, Liu HL, Liu GR, Yang B*
96	Molecular signatures of cytotoxic effects in human embryonic kidney 293 cells treated with single and mixture of ochratoxin A and citrinin	FOOD AND CHEMICAL TOXICOLOGY	123	374	384	3.775	Gong L, Zhu H, Li TT, Ming GF, Duan XW*, Wang JS, Jiang YM
97	Engineering low-cadmium rice through stress-inducible expression of OXS3-family member genes	NEW BIOTECHNOLOGY	48	29	34	3.739	Wang CH, Guo WL, Cai XZ, Li RY, Ow DW*

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98	Evolution and Diversification of Kiwifruit Mitogenomes through Extensive Whole-Genome Rearrangement and Mosaic Loss of Intergenic Sequences in a Highly Variable Region	GENOME BIOLOGY AND EVOLUTION	11	1192	1206	3.726	Wang SB, Li DW, Yao XH, Song QW, Wang ZP, Zhang Q, Zhong CH, Liu YF*, Huang HW*
99	Comparative transcriptomic and metabolic analysis reveals the effect of melatonin on delaying anthracnose incidence upon postharvest banana fruit peel	BMC PLANT BIOLOGY	19	289		3.670	Li TT, Wu QX, Zhu H, Zhou YJ, Jiang YM, Gao HJ*, Yun Z*
100	Genome-wide identification and classification of MIKC-type MADS-box genes in Streptophyte lineages and expression analyses to reveal their role in seed germination of orchid	BMC PLANT BIOLOGY	19	223		3.670	He CM, Si C, da Silva JAT, Li MZ, Duan J*
101	Identification and functional characterization of three new terpene synthase genes involved in chemical defense and abiotic stresses in Santalum album	BMC PLANT BIOLOGY	19	115		3.670	Zhang XH*, Niu MY, da Silva JAT, Zhang YY, Yuan YF, Jia YX, Xiao YY, Li Y, Fang L, Zeng SJ, Ma GH
102	The repetitive DNA landscape in Avena (Poaceae): chromosome and genome evolution defined by major repeat classes in whole-genome sequence reads	BMC PLANT BIOLOGY	19	226		3.670	Liu Q*, Li XY, Zhou XY, Li MZ, Zhang FJ, Schwarzacher T, Heslop-Harrison JS*
103	Quantifying Soil Phosphorus Dynamics: A Data Assimilation Approach	JOURNAL OF GEOPHYSICAL RESEARCH-BIOGEOSCIENCES	124	2159	2173	3.621	Hou EQ*, Lu XJ, Jiang LF, Wen DZ, Luo YQ*
104	Soil Organic Carbon Stabilization in the Three Subtropical Forests: Importance of Clay and Metal Oxides	JOURNAL OF GEOPHYSICAL RESEARCH-BIOGEOSCIENCES	124	2976	2990	3.621	Yu MX, Wang YP, Jiang J , Wang Ch, Zhou GY, Yan JH*
105	Intensified Precipitation Seasonality Reduces Soil Inorganic N Content in a Subtropical Forest: Greater Contribution of Leaching Loss Than N2O Emissions	JOURNAL OF GEOPHYSICAL RESEARCH-BIOGEOSCIENCES	124	494	508	3.621	Chen J, Kuzyakov Y, Jenerette GD, Xiao GL, Liu W, Wang ZF, Shen WJ*
106	Changes in pericarp metabolite profiling of four litchi cultivars during browning	FOOD RESEARCH INTERNATIONAL	120	339	351	3.579	Chen X, Wu QX, Chen ZSZ, Li TT, Zhang ZK, Gao HJ, Yun Z*, Jiang YM
107	New insights into fumonisin production and virulence of Fusarium proliferatum underlying different carbon sources	FOOD RESEARCH INTERNATIONAL	116	397	407	3.579	Jian QJ, Li TT, Wang Y, Zhang Y, Zhao ZY, Zhang XH, Gong L*, Jiang YM
108	Elucidation of (Z)-3-Hexenyl-beta-glucopyranoside Enhancement Mechanism under Stresses from the Oolong Tea Manufacturing Process	JOURNAL OF AGRICULTURAL AND FOOD CHEMISTRY	67	6541	6550	3.571	Zeng LT, Wang XQ, Xiao YY, Gu DC, Liao YY, Xu XL, Jia YX, Deng RF, Song CK, Yang ZY*
109	Increasing Temperature Changes Flux into Multiple Biosynthetic Pathways for 2-Phenylethanol in Model Systems of Tea (Camellia sinensis) and Other Plants	JOURNAL OF AGRICULTURAL AND FOOD CHEMISTRY	67	10145	10154	3.571	Zeng LT, Tan HB, Liao YY, Jian GT, Kang M, Dog F, Watanabe N, Yang ZY*

No.	Title	Journal Name	Issue Volume	Start	Stop	Impact Factor	Authors
110	Effect of Major Tea Insect Attack on Formation of Quality-Related Nonvolatile Specialized Metabolites in Tea (Camellia sinensis) Leaves	JOURNAL OF AGRICULTURAL AND FOOD CHEMISTRY	67	6716	6724	3.571	Liao YY, Yu ZM, Liu XY, Zeng LT, Cheng SH, Li JL, Tang JC, Yang ZY*
111	Cell wall proteome analysis of banana fruit softening using iTRAQ technology	JOURNAL OF PROTEOMICS	209	103506		3.537	Xiao L,Li TT,Jian,Jiang YM,Duan XW*
112	Banana sRNAome and degradome identify microRNAs functioning in differential responses to temperature stress	BMC GENOMICS	20	33		3.501	Zhu H*, Zhang Y, Tang RF, Qu HX, Duan XW, Jiang YM
113	RNA-Seq analysis of Clerodendrum inerme (L.) roots in response to salt stress	BMC GENOMICS	20	724		3.501	Xiong YP,Yan HF,Liang HZ,Zhang YY,Guo BY,Niu MY,Jian SG,Ren H,Zhang XH,Li Y,Zeng SJ,Wu KL,Zheng F,da Silva JAT,Ma GH*
114	Transcriptional regulatory networks controlling taste and aroma quality of apricot (Prunus armeniaca L.) fruit during ripening	BMC GENOMICS	20	45		3.501	Zhang QY, Feng C, Li WH, Qu ZH, Zeng M, Xi WP*
115	Rhizophols A and B, antioxidant and axially chiral benzophenones from the endophytic fungus Cytospora rhizophorae	ORGANIC & BIOMOLECULAR CHEMISTRY	17	10009	10012	3.490	Liu ZM, Tan HB, Chen K, Chen YC, Zhang WG, Chen SC, Liu HX*,Zhang WM*
116	Cytosporins A-D, novel benzophenone derivatives from the endophytic fungus Cytospora rhizophorae A761	ORGANIC & BIOMOLECULAR CHEMISTRY	17	2346	2350	3.490	Liu HX, Tan HB, Chen K, Zhao LY, Chen Y C, Li S N, Li HH, Zhang WM*
117	Water transport from stem to stomata: the coordination of hydraulic and gas exchange traits across 33 subtropical woody species	TREE PHYSIOLOGY	39	1665	1674	3.477	Liu XR, Liu H, Gleason SM, Goldstein G, Zhu SD, He PC, Hou H, Li RH, Ye Q*
118	Large branch and leaf hydraulic safety margins in subtropical evergreen broadleaved forest	TREE PHYSIOLOGY	39	1405	1415	3.477	Zhu SD*, Li RH, He PC, Siddiq Z, Cao KF, Ye Q*
119	Tree plantations influence the abundance of ammonia-oxidizing bacteria in the soils of a coral island	APPLIED SOIL ECOLOGY	138	220	222	3.445	Zhang W, Zhang H, Jian SG, Liu N*
120	A potential source of soil ecoenzymes: From the phyllosphere to soil via throughfall	APPLIED SOIL ECOLOGY	139	25	28	3.445	Mori T, Wang SH, Zhang W*, Mo JM*
121	Rhodomyrtosone B, a membrane-targeting anti-MRSA natural acylgphloroglucinol from Rhodomyrtus tomentosa	JOURNAL OF ETHNOPHAR-MACOLOGY	228	50	57	3.414	Zhao LY, Liu HX, Wang L, Xu ZF, Tan HB*, Qiu SX*
122	Patterns and controlling factors of plant nitrogen and phosphorus stoichiometry across China's forests	BIOGEO-CHEMISTRY	143	191	205	3.406	Liu JX, Fang X, Tang XL, Wang WT, Zhou GY*, Xu S, Huang WJ, Wang GX, Yan JH, Ma KP, Du S, Li SG, Han SJ, Ma YX

No.	Title	Journal Name	Issue Volume	Start	Stop	Impact Factor	Authors
123	Chemical composition and water permeability of the cuticular wax barrier in rose leaf and petal: A comparative investigation	PLANT PHYSIOLOGY AND BIOCHEMISTRY	135	404	410	3.404	Cheng GP, Huang H*, Zhou LY, He SG, Zhang YJ, Chen XA
124	The functional identification of glycine-rich TtASR from Tetragonia tetragonoides (Pall.) Kuntze involving in plant abiotic stress tolerance	PLANT PHYSIOLOGY AND BIOCHEMISTRY	143	212	223	3.404	Ye YY, Lin RY, Su HX, Chen HF, Luo M, Yang LX*, Zhang M*
125	Fibroin Delays Chilling Injury of Postharvest Banana Fruit via Enhanced Antioxidant Capability during Cold Storage	METABOLITES	9	152		3.303	Liu J, Li FJ, Liang L*, Jiang YM*, Chen JJ
126	Interactive effects of nitrogen and phosphorus additions on plant growth vary with ecosystem type	PLANT AND SOIL	440	523	537	3.259	Jiang J, Wang YP, Yang YH, Yu MX, Wang C, Yan JH*
127	Waterlogging tolerance of Bidens pilosa translates to increased competitiveness compared to native Bidens biternata	PLANT AND SOIL	437	301	311	3.259	Yue MF, Shen H*, Li WH, Chen JF, Ye WH, Tian XS, Yin AG, Cheng SM
128	Cellular barriers in apple tissue regulate polyphenol release under different food processing and in vitro digestion conditions	FOOD & FUNCTION	10	3008	3017	3.241	Liu DJ, Lopez-Sanchez P, Gidley MJ*
129	Global transcriptome and gene co-expression network analyses on the development of distyly in Primula oreodoxa	HEREDITY	123	784	794	3.179	Zhao ZT,Luo ZL*,Yuan S,Mei LN,Zhang DX*
130	Genetic architecture of quantitative flower and leaf traits in a pair of sympatric sister species of Primulina	HEREDITY	122	864	876	3.179	Feng C, Feng C, Yang LH, Kang M*, Rausher MD
131	Genetics of distyly and homostyly in a self-compatible Primula	HEREDITY	122	110	119	3.179	Yuan S, Barrett SCH, Li CH, Li XJ, Xie KP, Zhang DX*
132	Changes in taxonomic and phylogenetic dissimilarity among four subtropical forest communities during 30 years of restoration	FOREST ECOLOGY AND MANAGEMENT	432	983	990	3.126	Yu QS, Rao XQ, Ouyang SN, Xu Y, Hanif A, Ni Z, Sun D, He D, Shen WJ*
133	Recovery in soil carbon stock but reduction in carbon stabilization after 56-year forest restoration in degraded tropical lands	FOREST ECOLOGY AND MANAGEMENT	441	1	8	3.126	Zhang HL, Deng Q*, Hui DF, Wu JP, Xiong X, Zhao JQ, Zhao MD, Chu GW, Zhou GY, Zhang DQ*
134	Survivorship of plant species from soil seedbank after translocation from subtropical natural forests to plantation forests	FOREST ECOLOGY AND MANAGEMENT	432	741	747	3.126	Zhou QQ, Li F, Cai XA, Rao XQ, Zhou LX, Liu ZF, Lin YB, Fu SL*
135	Effects of phosphorus and nitrogen fertilization on soil arylsulfatase activity and sulfur availability of two tropical plantations in southern China	FOREST ECOLOGY AND MANAGEMENT	453	117613		3.126	Wang SH, Zhou KJ, Mori T, Mo JM, Zhang W*
136	Carotenoid-Derived Flavor Precursors from Averrhoa carambola Fresh Fruit	MOLECULES	24	256		3.060	Jia XC, Yang D, Yang Y, Xie HH*

No.	Title	Journal Name	Issue Volume	Start	Stop	Impact Factor	Authors
137	Immunomodulatory mechanism of alpha-D-(1 -> 6)-glucan isolated from banana	RSC ADVANCES	9	6995	7003	3.049	Wen LR, Shi DD, Zhou T, Liu HL, Jiang YM, Yang B*
138	Canopy transpiration and its cooling effect of three urban tree species in a subtropical city- Guangzhou, China	URBAN FORESTRY & URBAN GREENING	43	UNSP 126368		3.043	Chen X, Zhao P*, Hu YT, Ouyang L, Zhu LW, Ni GY
139	Icariin as a Preservative to Maintain the Fruit Quality of Banana During Postharvest Storage	FOOD AND BIOPROCESS TECHNOLOGY	12	1766	1775	3.032	Yang JL, Zhu H, Tu JM, Jiang YM, Zeng J, Yang B*
140	Seasonal dynamics of waterbird assembly mechanisms revealed by patterns in phylogenetic and functional diversity in a subtropical wetland	BIOTROPICA	51	421	431	2.989	Che XL, Chen DJ, Zhang M, Quan Q, Moller AP, Zou FS*
141	Phylogeny and ecological processes influence grass coexistence at different spatial scales within the steppe biome	OECOLOGIA	191	25	38	2.915	Liu H*, Osborne CP, Yin DY, Freckleton RP, Jiang GM, Liu MZ
142	Sulfur deposition still contributes to forest soil acidification in the Pearl River Delta, South China, despite the control of sulfur dioxide emission since 2001	ENVIRONMENTAL SCIENCE AND POLLUTION RESEARCH	26	12928	12939	2.914	Huang J, Zhou KJ, Zhang W, Liu JX, Ding X, Cai XA, Mo JM*
143	Heavy metal availability, bioaccessibility, and leachability in contaminated soil: effects of pig manure and earthworms	ENVIRONMENTAL SCIENCE AND POLLUTION RESEARCH	26	20030	20039	2.914	Li F, Li ZA*, Mao P, Li YW, Li YX, McBride MB, Wu JT, Zhuang P*
144	Acyl atractyligenin and carboxyatractyligenin glycosides from Antennaria rosea subsp. confinis	PHYTO-CHEMISTRY	157	151	157	2.905	Xiao YY, Lv L, Gou P, Xie HH*
145	Manglietia pubipedunculata (Magnoliaceae), a new species from Yunnan, China	PLOS ONE	14	e0210254		2.776	Hu XM, Zeng QW, Liu YS, Fu L, Xi RC, Chen HF*, Deng XM*
146	The plastid genome and its implications in barcoding specific-chemotypes of the medicinal herb Pogostemon cablin in China	PLOS ONE	14	e0215512		2.776	Zhang CY, Liu TJ, Yuan X, Huang HR, Yao G, Mo XL, Xue X, Yan HF*
147	Negative effects of canopy N addition on soil organic carbon in wet season are primarily detected in uppermost soils of a subtropical forest	GLOBAL ECOLOGY AND CONSERVATION	17			2.751	Lu XF, Ren WD, Hou EQ, Zhang LL, Wen DZ, Liu ZF, Lin YB, Wang J, Kuang YW*
148	Main and interactive effects of increased precipitation and nitrogen addition on growth, morphology, and nutrition of Cinnamomum burmanni seedlings in a tropical forest	GLOBAL ECOLOGY AND CONSERVATION	20	e00734		2.751	Wang J, Hui DF, Lu HF, Wang FM, Liu N, Sun ZY, Ren H*
149	Stand age and species traits alter the effects of understory removal on litter decomposition and nutrient dynamics in subtropical Eucalyptus plantations	GLOBAL ECOLOGY AND CONSERVATION	20	e00693		2.751	Chen YQ, Zhang YJ, Cao JB, Fu SL, Hu SJ, Wu JP, Zhao J, Liu ZF*

No.	Title	Journal Name	Issue Volume	Start	Stop	Impact Factor	Authors
150	Proteomic and transcriptomic analysis to unravel the influence of high temperature on banana fruit during postharvest storage	FUNCTIONAL & INTEGRATIVE GENOMICS	19	467	486	2.745	Li TT, Wu QX, Duan XW, Yun Z*, Jiang YM
151	Nucleocytoplasmic OXIDATIVE STRESS 2 can relocate FLOWERING LOCUS T	BIOCHEMICAL AND BIOPHYSICAL RESEARCH COMMUNICA-TIONS	517	735	740	2.705	Liang MT, David W. Ow*
152	OXIDATIVE STRESS 3 regulates drought-induced flowering through APETALA 1	BIOCHEMICAL AND BIOPHYSICAL RESEARCH COMMUNICA-TIONS	519	585	590	2.705	Liang MT, Xiao SM, Cai JJ,David W. Ow*
153	Formation pattern in five types of pollen tetrad in Pseuduvaria trimera (Annonaceae)	PROTOPLASMA	256	53	68	2.633	Li BX, Xu FX*
154	Nitrogen addition method affects growth and nitrogen accumulation in seedlings of four subtropical tree species: Schima superba Gardner & Champ., Pinus massoniana Lamb., Acacia mangium Willd., and Ormosia pinnata Lour	ANNALS OF FOREST SCIENCE	76	23		2.633	Wu T, Lin W, Li YY, Lie ZY, Huang WJ, Liu JX*
155	Plant Taxonomic Diversity Better Explains Soil Fungal and Bacterial Diversity than Functional Diversity in Restored Forest Ecosystems	PLANTS-BASEL	8	479		2.632	Hanif MA, Guo ZM, Moniruzzaman M, He D, Yu QS, Rao XQ, Lu SP, Tan XP, Shen WJ*
156	Seasonal water use strategy of canopy tree species and possible implication for their coexistence in a subtropical secondary forest	ECOHYDROLOGY	12	UNSP e2129		2.564	Ouyang L, He W, Huang KC, Zhou CM, Gu DX, Huang YQ, Zhao P*
157	Exogenous plant growth regulators improved phytoextraction efficiency by Amaranths hypochondriacus L. in cadmium contaminated soil	PLANT GROWTH REGULATION				2.473	Sun S, Zhou XF, Cui XY, Liu CP, Fan YX, McBride MB, Li YW, Li Z*, Zhuang P*
158	In Vitro and In Vivo Testing to Determine Cd Bioaccessibility and Bioavailability in Contaminated Rice in Relation to Mouse Chow	INTERNATIONAL JOURNAL OF ENVIRONMENTAL RESEARCH AND PUBLIC HEALTH	16	871		2.468	Sun S, Zhou XF, Li Z*, Zhuang P*
159	Removal of Total Nitrogen and Phosphorus Using Single or Combinations of Aquatic Plants	INTERNATIONAL JOURNAL OF ENVIRONMENTAL RESEARCH AND PUBLIC HEALTH	16	4663		2.468	Su F, Li ZA, Xu L, Li YX, Li SY, Chen HF, Zhuang P*, Wang FG*
160	Two pairs of enantiomeric propylated flavonoids and a new lignan from the aerial parts of Abrus precatorius	FITOTERAPIA	133	125	129	2.431	Li Y, Qin XB, Liu HX,Xu ZF, Tan HB*, Qiu SX*

No.	Title	Journal Name	Issue Volume	Start	Stop	Impact Factor	Authors
161	Chemical constituents of the trunks and roots of Thuja sutchuenensis	FITOTERAPIA	134	264	269	2.431	Guo XY, Wang MM, Wu JF, Wu GY, Zhang X, Huo LQ, Liu HX, Chen YH, Xie GW*, Tan HB*, Qiu SX*
162	Comparative metabolites profiling of harvested papaya (Carica papaya L.) peel in response to chilling stress	JOURNAL OF THE SCIENCE OF FOOD AND AGRICULTURE				2.422	Wu QX, Li ZW, Chen X, Yun Z, Li TT*, Jiang YM
163	Comparative volatile compounds and primary metabolites profiling of pitaya fruit peel after ozone treatment	JOURNAL OF THE SCIENCE OF FOOD AND AGRICULTURE	99	2610	2621	2.422	Wu QX, Zhang ZK, Zhu H, Li TT, Zhu XR, Gao HJ*, Yun Z*, Jiang YM
164	The use of DNA barcodes to estimate phylogenetic diversity in forest communities of southern China	ECOLOGY AND EVOLUTION	9	5372	5379	2.415	Liu JJ, Liu J, Shan YX, Ge XJ*, Burgess KS*
165	Changes in seasonal precipitation distribution but not annual amount affect litter decomposition in a secondary tropical forest	ECOLOGY AND EVOLUTION	9	11344	11352	2.415	Yu SQ, Mo QF, Li YW, Li YX, Zou B, Xia HP, Li ZA*, Wang FM*
166	Endangered but genetically stable-Erythrophleum fordii within Feng Shui woodlands in suburbanized villages	ECOLOGY AND EVOLUTION	9	10950	10963	2.415	Wang ZF, Liu HL, Dai SP*, Cao HL, Wang RJ, Wang ZM
167	Responses of bud-break phenology to daily-asymmetric warming: daytime warming intensifies the advancement of bud break	INTERNATIONAL JOURNAL OF BIOMETEO-ROLOGY	63	1631	1640	2.377	Zhang SK, Isabel N, Huang JG*, Ren H, Rossi S
168	Morphological, anatomical and physiological traits of Euryodendron excelsum as affected by conservation translocation (augmentation vs. conservation introduction) in South China	PHOTOSYN-THETICA	57	217	225	2.365	Ren H*, Yi HL, Zhang QM, Wang J, Wen XY, Guo QF, Liu H
169	Plastome of mycoheterotrophic Burmannia itoana Mak. (Burmanniaceae) exhibits extensive degradation and distinct rearrangements	PEERJ	7	e7787		2.353	Li XJ, Qian X, Yao G, Zhao ZT*, Zhang DX*
170	Identification of Austwickia chelonae as cause of cutaneous granuloma in endangered crocodile lizards using metataxonomics	PEERJ	7	e6574		2.353	Jiang HY, Zhang XJ, Li LM, Ma JG, He N, Liu HY, Han RC, Li HM, Wu ZJ, Chen JP*
171	Overexpression of OsFTL10 induces early flowering and improves drought tolerance in Oryza sativa L.	PEERJ	7	e6422		2.353	Fang MC, Zhou ZJ, Zho XS, Yang HY, Li MR*, Li HQ*
172	Specific responses of sap flux and leaf functional traits to simulated canopy and understory nitrogen additions in a deciduous broadleaf forest	FUNCTIONAL PLANT BIOLOGY	46	986	993	2.327	Zhu LW, Hu YT, Zhao XH, Zhao P*, Ouyang L, Ni GY, Liu N
173	Identification and Expression Analysis of Snf2 Family Proteins in Tomato (Solanum lycopersicum)	INTERNATIONAL JOURNAL OF GENOMICS		5080935		2.303	Zhang DD, Gao SJ, Yang P, Yang J, Yang SG*, Wu KQ*
174	Hydrologic balance, net primary productivity and water use efficiency of the introduced exotic Eucalyptus grandis × Eucalyptus urophylla plantation in south-western China	JOURNAL OF PLANT ECOLOGY	12	982	992	2.282	Hu YT, Zhao P*, Huang YQ, Zhu LW, Ni GY, Zhao XH, Huang ZH
175	Comparison of the effects of canopy and understory nitrogen addition on xylem growth of two dominant species in a warm temperate forest, China	DENDROCHRON-OLOGIA	56	UNSP 125604		2.281	Yu BY, Huang JG*, Ma QQ, Guo XL, Liang HX, Zhang SK, Fu SL, Wan SQ, Yan JH, Zhang W
176	Growth and physiological alterations related to root-specific gene function of LrERF061-OE in Glycyrrhiza uralensis Fisch. hairy root clones under cadmium stress	PLANT CELL TISSUE AND ORGAN CULTURE				2.200	Chahel AA, Yousaf Z*, Zeng SH*, Li YP, Ying W*
177	Plant-specific transcription factor LrTCP4 enhances secondary metabolite biosynthesis in Lycium ruthenicum hairy roots	PLANT CELL TISSUE AND ORGAN CULTURE	136	323	337	2.200	Chahel AA, Zeng SH*, Yousaf Z*, Liao YY, Yang ZY, Wei XY, Ying W*
178	NaCl-induced stress: physiological responses of six halophyte species in in vitro and in vivo culture	PLANT CELL TISSUE AND ORGAN CULTURE	139	531	546	2.200	Xiong YP, Liang HZ, Yan HF, Guo BY, Niu MY, Chen SY, Jian SG, Ren H, Zhang XH, Li Y, Zeng SJ, Wu KL, Zheng F, da Silva JAT, Ma GH*
179	Recurrent somatic embryogenesis and development of somatic embryos in Akebia trifoliata (Thunb.) Koidz (Lardizabalaceae)	PLANT CELL TISSUE AND ORGAN CULTURE	139	493	504	2.200	Zou SY, Yao XH, Zhong CH, Li DW, Wang ZP, Huang HW*
180	Molecular Cloning and Functional Analysis of Three CONSTANS-Like Genes from Chinese Cymbidium	JOURNAL OF PLANT GROWTH REGULATION				2.179	Zhang JX*, Zhao XL, Tian RX, Zeng SJ, Wu KL, da Silva JAT*, Duan J*
181	Use of horticultural mineral oils to control potato virus Y (PVY) and other non-persistent aphid-vectored viruses	CROP PROTECTION	118	97	103	2.172	Yang QY, Arthurs S, Lu ZX, Liang ZY, Mao RQ*
182	The Combined Role of Retention Pattern and Post-Harvest Site Preparation in Regulating Plant Functional Diversity: A Case Study in Boreal Forest Ecosystems	FORESTS	10	1	19	2.116	Wei LP*, Fenton NJ, Lafleur B, Bergeron Y
183	Understanding Community Assembly Based on Functional Traits, Ontogenetic Stages, Habitat Types and Spatial Scales in a Subtropical Forest	FORESTS	10	1	16	2.116	Li YP, Bin Y, Xu H, Ni YL, Zhang RY, Ye WH, Lian JY*
184	Changes in Soil Microbial Biomass, Community Composition, and Enzyme Activities After Half-Century Forest Restoration in Degraded Tropical Lands	FORESTS	10	1124		2.116	Zhang HL, Xiong X, Wu JP, Zhao JQ, Zhao MD, Chu GW, Hui DF, Zhou GY, Deng Q*, Zhang DQ*
185	Forest Soil Profile Inversion and Mixing Change the Vertical Stratification of Soil CO2 Concentration without Altering Soil Surface CO2 Flux	FORESTS	10	192		2.116	Wang XL, Fu SL, Li JX, Zou XM, Zhang WX, Xia HP, Lin YB, Tian Q, Zhou LX*

Appendix II. Organizational Structure

Leadership

Directors
Director: REN Hai
Deputy Directors: JIANG Yueming, YAN Junhua

Committee of CPC
Secretary: ZHANG Fusheng
Members: ZHANG Fusheng, REN Hai, HUANG Hongwen, ZHOU Guoyi, XIA Hanping, FAN Dequan, LIAO Jingping

Disciplinary Committee of CPC
Secretary: ZHANG Fusheng
Members: ZHANG Fusheng, YAN Junhua, CHEN Zhenhuan, GONG Xiaoping, WANG Ruijiang

Director Assistants
YE Qing, WANG Ying, FAN Dequan

Administration Units

General Office
Director: FAN Dequan
Deputy Director: ZHENG Xiangci

Scientific Research and Foreign Affairs Management Division
Director: CHEN Feng
Deputy Director: YU Yan

Personnel and Education Division
Director: GONG Xiaoping
Deputy Director: LAI Zhimin

Assets and Financial Services Division
Director: FAN Linxian
Deputy Director: KE Qiusheng

Science and Technology Development Center
Director: WANG Keya

Horticulture Center
Director: YAN Junhua
Deputy Director: LIAO Jingping, XIA Hanping

Dinghushan Nature Reserve (Arboretum)
Director: YE Qing
Deputy Directors: MO Jiangming, OUYANG Xuejun

Discipline Inspection and Supervision Audit Office
Director: CHEN Zhenhuan

Research Teams

Plant Sciences Center

Director: Prof. / Dr. KANG Ming
Deputy Director: Prof. / Dr. LUO Shixiao

Research Group for Plant Phylogenetics and Reproductive Biology
PI: Prof. / Dr. ZHANG Dianxiang
Members: LUO Shixiao, LI Shijin, LUO Zhonglai, TU Tieyao, SHI Miaomiao, ZHAO Zhongtao, WANG Xiangping

Research Group for Plant Structural and Development Biology
PI: Prof. / Dr. LIAO Jingping
Members: XU Fengxia, ZOU Pu, LIU Huanfang, KUANG Yanfeng

Research Group for Plant Molecular Systematics and Evolution
PI: Prof. / Dr. WANG Ruijiang
Members: DONG Shiyong, XU Yuan

Research Group for Taxonomy of Seed Plants
PI: Prof. / Dr. Yang Qin'er
Members: YUAN Qiong, REN Chen, WANG Long

Research Group for Conservation Genetics
PI: Prof. / Dr. KANG Ming
Members: WANG Jing, KONG Hanghui, FENG Chao, YANG Lihua

Research Group for Plant Species Diversity and Conservation
PI: Prof. / Dr. CHEN Hongfeng

Members: WANG Faguo, LIU Dongming, YI Qifei, YE Wen, FU Lin, DUAN Lei

Research Group for Plant Taxonomy and Resources
PI: Prof. / Dr. XIA Nianhe
Members: CHEN Juan,TONG Yihua

Research Group for Plant Taxonomy and Biogeography
PI: Prof. / Dr. DENG Yunfei
Members: LIN Zheli

Research Group for Coevolution of Plant and Insect
PI: Prof. / Dr. YU Hui

Research Group for Molecular Ecology
PI: Prof. / Dr. GE Xuejun
Members: YAN Haifei, HUANG Huirun, LIU Jiajia, LIU Tongjian

Research Group for Evolution and Ecological Genomics
PI: Prof. / Dr. WANG Baosheng
Members: YUAN Shuai, SHI Yong

Research Group for Plant Genome Evolution
PI: Prof. / Dr. Pat Heslop Harrison
Members: LIU Qing

Research Group for Plant Orthodox Taxonomy and Species Diversity
PI: Prof. / Dr. CHEN Yousheng
Members: SONG Zhuqiu

Ecological & Environmental Sciences Center

Director: Prof. / Dr. YE Qing
Deputy Director: Prof. / Dr. HUANG Jianguo

Research Group for Ecosystem Ecology
PI: Prof. / Dr. LIU Juxiu
Members: YAN Junhua, Liu Juxiu, TANG Xuli, LI Yuelin

Research Group for Ecosystem Physiology
PI: Prof. / Dr. ZHAO Ping
Members: OUYANG Lei, NI Guangyan, ZHU Liwei

Research Group for Global Change and Plant Functional Traits
PI: Prof. / Dr. YE Qing
Members: LIU Hui, YIN Deyi

Research Group for Ecosystem Management
PI: Prof. / Dr. MO Jiangming
Members: LU Xiankai, ZHANG Wei, HUANG Juan, MAO Qinggong

Research Group for Conservation Ecology
PI: Prof. / Dr. YE Wanhui
Members: WANG Zhenfeng, CAO Honglin, SHEN Hao, LIU Wei, LIAN Juyu, BIN Yue, MEI Qiming

Research Group for Restoration Ecology
PI: Prof. / Dr. LIU Zhanfeng
Members: ZHOU Lixia, CAI Xi'an, ZHANG Jing, WU Wenjia

Research Group for Vegetation and Landscape Ecology
PI: Prof. / Dr. JIAN Shuguang
Members: REN Hai, LU Hongfang, LIU Nan, WANG Jun, LIU Hongxiao, WEI Liping

Research Group for Soil Science and Ecological Engineering
PI: Prof. / Dr. LI Zhi'an
Members: XIA Hanping, WANG Fangming, ZHUANG Ping, ZOU Bi, LI Xiaobo

Research Group for Environmental Ecology
PI: Prof. / Dr. WEN Dazhi
Members: KUANG Yuanwen, ZHANG Lingling

Research Group for Forest Ecology and Simulation
PI: Prof. / Dr. HUANG Jianguo
Members: MA Qianqian, ZHU Huoxing

Research Group for Global Change and Ecological Processes
PI: Prof. / Dr. SHEN Weijun
Members: TAN Xiangping, HUANG Feng, NIE Yanxia, HE Dan

Research Group for Land Surface Biogeochemical Cycles
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Members: WANG Chen, WANG Linhua, JIANG Jun

Research Group for Ecosystem Stoichiometry
PI: Prof. / Dr. Deng Qi
Members: LI Jianling

Agriculture & Resource Plant Center

Director: Prof. / Dr. WANG Ying
Deputy Director: Prof. / Dr. YANG Ziyin

Research Group for Postharvest Biology
PI: Prof. / Dr. JIANG Yueming
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