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中国几个植物类群的研究进展
Ⅰ. 中国兰科植物研究的回顾与前瞻

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摘要: 中国有丰富的兰科植物资源和悠久的栽培与观赏兰花的历史。在我国古代的文学艺术著作中,人们得知:早在公元前6~10世纪就有兰科植物的记载,北宋时期就有兰花画卷问世,13世纪就有兰花专著出版。近年研究表明,兰属植物在中国的栽培始于唐朝后期,大约在公元860~890年之间,而不是孔子时代。

第一位给中国兰科植物以科学命名的是林奈(Species Plantarum, 1753)。在那以后,许多欧洲植物学家开始研究中国兰科植物,其中R. A. Rolfe、R. Schlechter和近代的G. Seidenfaden及P. Cribb是特别值得称颂的。他们的论著至今仍是不可或缺的参考文献。

在1925年胡先骕成为第一位研究中国兰科植物的中国植物学家。紧接着,在上世纪30年代,钱崇澍、左景烈、唐进和汪发缵也开始研究兰科。此后,唐进和汪发缵坚持不懈,继续从事中国及其邻近地区兰科植物的研究达数十年之久,并发表了许多有价值的论著,为尔后中国兰科的研究打下了坚实的基础。

在初期,研究工作主要集中在对兰科植物的采集、鉴定和分类方面。继之是编研《中国植物志》(兰科)。在野外工作中采集到大量的兰科标本和拍摄到数以万计的彩色照片。在此基础上发表了许多著作和论文,包括三卷《中国植物志》(17~19卷)。

在兰科植物区系与地理方面,对一些地区与山系开展了研究,如四川、西藏、台湾、云南南部的西双版纳和横断山区等。主要成果包括:标定石上附生兰的北界和西界,它与亚热带的北界与西界大致相符;划出中国-喜马拉雅与中国-日本亚区在四川境内的分界线,称楷永线;建议台湾划入植物区系分区中的古热带区马来亚区;提出:附生兰属占该地区全部兰科总属数的50%以上者,应视为热带植物区系的标志。

我国对兰科微观形态的研究始于上个世纪80年代,大约对40属150种的兰科植物进行过细胞学、孢粉学、解剖学或生理学的研究,其中大多是我国原产植物,如石斛属(*Dendrobium*)、兰属(*Cymbidium*)、白及属(*Bletilla*)、万代兰属(*Vanda*)、独蒜兰属(*Pleione*)、杓兰属(*Cypripedium*)、舌喙兰属(*Hemipilia*)、兜被兰属(*Neottianthe*)、天麻属(*Gastrodia*)、开唇兰属(*Anoectochilus*)、鹤顶兰属(*Phaius*)和兜兰属(*Paphiopedilum*)中的一些种类。只有少数为引种的植物或杂种,主要是香荚兰属(*Vanilla*)、蝴蝶兰属(*Phalaenopsis*)、树兰属(*Epidendrum*)、卡特兰属(*Cattleya*)和文心兰属(*Oncidium*)中的一些种类。

兰花涉及重要的产业。长期以来,试管繁殖在我国受到很大的重视。在许多属中,对组织培养、种子萌发和种苗培植的试验已取得成功,诸如兰属、石斛属、开唇兰属、苞舌兰属(*Spathoglottis*)、五唇兰属(*Doritis*)、香荚兰属、蝴蝶兰属、卡特兰属和树兰属等。人工杂种也已在兜兰属、兰属、石斛属、蝴蝶兰属、鹤顶兰属和虾脊兰属(*Calanthe*)中培育成功。但许多工作主要是科研性质的,而非商业性质的。只有极少数杂种推向市场。

兰属植物是我国最受欢迎的观赏兰花。目前在大陆、台湾与香港已建有数百个国兰种植场和数目更加庞大的家庭兰园。已出版了数十部有关国兰品种的通俗著作。兰花展览会也在频繁地举办。此举虽然使数百万的兰花爱好者从中获益,但负面影响是使多种兰属植物变得极度濒危或十分稀有。

天麻(*Gastrodia elata* Bl.)作为民间药物在我国已使用了约2 000年之久,今天仍然在传统中药中占据重要的地位。已对天麻进行了综合研究,包括试管繁殖、栽培和生产等,均已取得成功。其关键是在种子萌发时加入紫萁小菇(*Mycena osmundicola* Lange)和在原球茎生成后加入蜜环菌(*Armillariella mella* (Vahl. ex Franch.) Karst)。

在我国,已对兰属、石斛属、石豆兰属(*Bulbophyllum*)、羊耳蒜属(*Liparis*)、万代兰属、拟万代兰属(*Vandopsis*)、毛兰属(*Eria*)中44个种进行过菌根研究。已有13属真菌被分离和鉴定出:*Ceratorhiza*、*Eulorhiza*、*Moniliopsis*、*Fusarium*、*Mycena*、*Cylindrocarpon*、*Myceliophthoreae*、*Cephalosporium*、*Ceratorhiza*、*Chromosporium*、*Rhizoctomia*、*Gloiocladium* 和 *Pestalotina*。对天麻与真菌,特别是小菇属(*Mycena*)与蜜环菌属(*Armillariella*)之间的共生萌发和生长,已有深入的研究。

中国植物学家在上世纪90年代开始研究兰花传粉生物学。鸟足兰属(*Satyrium*)、舌喙兰属、独花兰属(*Changnienia*)、槽舌兰属(*Holcoglossum*)、杓兰属和兜兰属中的某些种被观察过,但至今仅发表过2篇关于舌喙兰属和独花

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兰属的论文。据报道，扇唇舌喙兰（*Hemipilia flabellata* Bur. et Franch.）是依靠欺骗以吸引访问者。它的花与唇形花科的痢止菊（*Ajuga forrestii* Diels）颇为相似。后者似乎是惟一为传粉者提供辅助蜜源的植物。

近年来，我国对兰科植物的保护甚为重视，提出了总的方针，并采取措施以图改善野生种的保护。事实上，保护是一个复杂的问题，不仅取决于教育和经济的发展，相当大程度上还取决于兰科植物自身的生物学特性。需要对其生态学、居群生物学、传粉生物学、繁育生物学以及其他生物学分支学科进行研究。近年已对独花兰属、金佛山兰属、兜兰属和杓兰属中的某些种开展了研究。但是，我们依然面临的是，对植物自身情况的了解甚为贫乏或十分有限，特别是引起兰花濒危的生物学原因。

中国自上世纪20年代以来，对兰科植物的研究已取得了长足的进展。展望未来，主要目标应当是：在科学上进一步综合研究中国特有、亚特有类群，或是主要产于中国的类群；在商业上对有重要观赏或药用价值的种类进行应用研究。其中最重要的是：兜兰属、石斛属、杓兰属、兰属、独蒜兰属、槽舌兰属、开唇兰属以及兰亚族中的一些类群，以及从国外引进的观赏属。当然，将来需要更多的国际合作。

关键词： 兰科；中国；历史；植物区系；植物地理学；微观形态；试管繁殖；菌根；传粉生物学；保护

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Advances in Some Plant Groups in China
Ⅰ. A Retrospect and Prospect of Orchidology in China

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Abstract: China is rich in orchid resources and has a long history of orchid appreciation and cultivation. In Chinese ancient literary and artistic works, one can find orchid names as early as about 10th – 6th century B. C., orchid paintings in the Northern Song Dynasty (960 – 1 127) and orchid monographs in the 13th century. Some recent investigations revealed that the cultivation of cymbidiums in China began in the late Tang Dynasty between 860 and 890 A. D. rather than in Confucious times.

The first scientific name assigned to Chinese orchids was by Linnaeus in Species Plantarum (1753). Since then many European botanists paid attention to Chinese orchids. Among them R. A. Rolfe, R. Schlechter and recently G. Seidenfaden and P. Cribb are particularly praiseworthy. Their works are considered to be indispensable references until today.

In China, H. H. Hu was the first botanist to make a special study on Chinese orchids in 1925, closely followed by S. S. Chien, C. L. Tso, T. Tang and F. T. Wang in the 1930s. After that T. Tang and F. T. Wang continued to study the orchids of China and neighboring areas for decades of years and published many valuable works. They laid a solid foundation for an understanding of the orchid flora of China.

At the beginning, the research work was concentrated on the collection, identification and classification of orchids, and then the compilation of the Orchid Flora of China (Flora Reipublicae Popularis Sinicae: Orchidaceae). As a result, a large number of orchid specimens were collected, and nearly ten thousands of colored photographs were taken, and on this ground many books and articles have been published, including three volumes of the Flora Reipublicae Popularis Sinicae (vol. 17 – 19).

Floristic and phytogeographical studies on orchids were made in some areas or mountain chains, such as Sichuan, Xizang (Tibet), Taiwan, Xishuangbanna of southern Yunnan and the Hengduan Mountains. The main achievements include: marking the northern and western limits of lithophytic orchids in China, which almost correspond to those of subtropics; proposing a line, called Kaiyong-Line, separating the Sino-Himalaya and Sino-Japanese Subkingdoms in Sichuan Province; putting forward a suggestion to treat Taiwan as a subdivision of the Malay Subregion of Paleotropical Region floristically; and making a proposal that the proportion of the epiphytic orchid genera amounting to 50% of the total orchid genera might be considered as a symbol of tropical flora.

Working on micromorphology of orchids began in the eighties of the last century in China. Nearly 150

species belonging to 40 genera of orchids have been studied cytologically, palynologically, anatomically, embryologically and physiologically. Most of them are natives of China, such as the species of *Dendrobium*, *Cymbidium*, *Bletilla*, *Vanda*, *Pleione*, *Cypripedium*. *Hemipilia*, *Neottianthe*, *Gastrodia*, *Anoectochilus*, *Phaius* and *Paphiopedilum*. Only a few are introduced taxa or hybrids, mostly in *Vanilla*, *Phalaenopsis*, *Epidendrum*, *Cattleya* and *Oncidium*.

Orchids relate to a thriving industy. Great attention has long been paid to their micropropagation in China. The experiments in tissue culture, seed germination and seedling culture have succeeded in many genera, such as *Cymbidium*, *Dendrobium*, *Anoectochilus*, *Spathoglottis*, *Doritis*, *Vanilla*, *Phalaenopsis*, *Cattleya* and *Epidendrum*. Artificial hybrids have been bred in *Paphiopedilum*, *Cymbidium*, *Dendrobium*, *Phalaenopsis*, *Phaius* and *Calanthe*. However, a lot of work was done more scientifically than commercially. Only few hybrids have been found in markets.

Cymbidiums are among the best of the favorable ornamental orchids in China. In recent years, several hundreds of *Cymbidium* plantations, as well as much more private yards, have been set up in China mainland, Taiwan and Hong Kong. Decades of popular books on their cultivars have been published, and the orchid exhibitions are held frequently. Although it is beneficial to millions of orchid amateurs, many species of *Cymbidium* have become seriously endangered or quite rare.

As a kind of folk drugs, *Gastrodia elata* Bl. was used in China some 2 000 years ago, and still occupies an important place in traditional Chinense medicine today. A comprehensive study has been made on this species. Its micropropagation, cultivation and production have succeeded by adding *Mycena osmundicola* Lange to its seeds, and then *Armillariella mellea* (Vahl. ex Franch.) Karst. to its protocorms.

In China, orchid microrrhizae have been studied of 44 species belonging to 20 genera, such as *Cymbidium*, *Dendrobium*, *Bulbophyllum*, *Liparis*, *Vanda*, *Vandopsis*, *Eria*, etc. Altogether 13 genera of fungi have been isolated and identified: *Ceratorhiza*, *Epulorhiza*, *Moniliopsis*, *Fusarium*, *Mycena*, *Cylindrocarpon*, *Myceliophthoreae*, *Cephalosporium*, *Ceratorhiza*, *Chromosporium*, *Rhizoctomia*, *Gloiocladium* and *Pestalotina*. The symbiotic germination and growth between *Gastrodia elata* and fungi, especially *Mycena* and *Armillariella*, have been closely investigated.

Chinese botanists began to work on pollination biology of orchids in the 1990s. Some species of *Satysium*, *Hemipilia*, *Changnienia*, *Holcoglossum*, *Cypripedium* and *Paphiopedilum* have been observed, but only two articles have been published on *Hemipilia* and *Changnienia* until recently. *Hemipilia flabellate* Bur. et Franch. was reported relying on deception to attract visitors. Its flowers are similar to those of *Ajuga forrestii* Diels (Labiatae). The latter appears to be the main or exclusive subsidiary nectar source for the pollinators.

Recently great attention has been paid to orchid conservation in China. General policies have been carried out and some efforts have been made to improve the situation. This is in fact a complicated problem, not only depending on education and economic development, but also to a large extent on the biological characters of the orchids themselves. It needs a comprehensive study of ecology, population biology, pollination biology, breeding biology and other biological branches. In recent years, studies have been made on some species of *Changnienia*, *Tangtsinia*, *Paphiopedilum* and *Cypripedium*. However, we still face having little or limited knowledge of the plants themselves, particularly the biological factors that cause orchids to be endangered.

China has made good progress in orchidology since the twenties of the last century. Looking forward to the future, the main target is to make scientifically further and comprehensive studies on those taxa endemic or subendemic to China or distributed mainly in China, and commercially applied studies on those of ornamental or medicinal significance. Among the most important genera, for example, are *Paphiopedilum*, *Dendrobium*, *Cypripedium*, *Cymbidium*, *Pleione*, *Holcoglossum*, *Anoectochilus* and some taxa in subtribe Orchidinae and those introduced from abroad. Of course, more international collaboration will be needed in the future.

Key words: Orchidaceae; China; history; floristics; phytogeography; micromorphology; micropropagation; microrhizae; pollination biology; conservation

兰科是世界性的大科，约有 700 属 20 000 种，主要分布于热带地区。我国有 171 属 1 247 种，与菊科、禾本科、豆科并列为国产被子植物四大科之一。

兰科有三大特点：第一，它是被子植物中最为进化的科之一。花的结构十分复杂，出现了雌雄合体的蕊柱（Column）和花粉块（Pollinarium）。高度特化的繁殖器官与适应于昆虫传粉的精巧结构使生物学家产生了浓厚的兴趣。达尔文生前留下的若干巨著中就包括了一部有关兰花传粉的著作。兰科植物与昆虫的协同进化仍是今日生物学研究中的热门学科之一。其次，兰花中有许多种类色彩艳丽、花期长，有很高的商业价值。兰花产业已成为国际花卉业的重要组成部分。第三，兰科植物在受保护的濒危物种中占很大的比例。1973 年由 IUCN 建议各国政府联合制定的《野生动植物濒危物种国际贸易公约》（简称（CITES））中，我国被列入重点保护的植物约有 1 300 种，而兰科则占了 1 200 余种，达 90% 以上。因此，兰科是一个特殊的植物群，对其进行研究，不论在学术、生物多样性保护，还是产业可持续发展等方面均有重要的意义。

我国关于兰科植物的记载可追溯到公元前 600 ~ 1 000 年，而兰科专著则出现于 13 世纪。这在世界上都是首屈一指的。但最早给中国兰科植物以科学命名的，应首推 C. Linnaeus。他在 1753 年根据采自广州黄埔的兰科植物命名为 *Epidendrum ensifolium*（Species plantarum, 1753）（即今建兰 *Cymbidium ensifolium*）。此后陆续有许多欧洲学者研究中国兰科植物，其中不乏有较大成就者，如 R. A. Rolfe、R. Schlechter 以及近代的 G. Seidenfaden 与 P. Cribb（Chen and Tang, 1982; Chen *et al.*, 1999a）。他们的论著至今仍有重要的参考价值。

我国近代学者对于兰科植物的研究始于上世纪 20 年代中期。最早的兰科研究论文是由胡先骕（Hu, 1925）发表的。他命名的风兰属，至今仍沿用 *Neofinetia* Hu。其次是钱崇澍（Chien, 1930; 1931; 1935）。他发现的独花兰属（*Changnienia* Chien）为我国特有属。再次是左景烈对广东兰科植物的研究（Tso, 1933）。但他们涉猎的面较广，后来就不再研究兰科了。而中国兰科研究的奠基人应是唐进和汪发缵。他们在 30 年代中期开始发表兰科文章（Tang and Wang, 1934; 1936a; 1936b），并亲赴欧洲进行了长达 3 年（1935 ~ 1938）的研究。研究的范围也扩大至东亚，包括越南、缅甸、泰国、印度、日本和朝鲜。他们在深入研究国内各主要标本室的兰科标本后，挑选重要的带到欧洲，并将收藏于美国五大标本馆中的中国兰科植物标本商借至欧洲进行研究。他们遍访了欧洲最重要的标本馆，如柏林植物园标本馆（B）、伦敦邱园标本馆（K）、大英博物院（BM）、爱丁堡植物园标本馆（E）、维也纳博物馆（W）、法国国家博物馆（P）等。就当时条件而言，这是极其难得的。他们归国时带回了大量的文稿，并发表了许多重要的论文（Tang and Wang, 1940; 1951a; 1951b; 1951c; 1954; 1974; Tang and Chen, 1977; Tang *et al.*, 1980; 1982），为研究中国兰科植物奠定了坚实的基础。

新中国成立后，植物分类学的研究有了很大的发展，主要是围绕编写《中国植物志》的任务展开的。兰科的研究也不例外，首先是种、属的鉴定和整理，继后是兰史考辨、分类系统、区系地理、微观形态、组织培养、栽培生产以及共生真菌、传粉生物学、保护生物学等方面的研究，均取得了明显的进展。兹分述如下：

1　古代兰史

兰史是兰科研究中不可缺少的组成部分。我国是文明古国，对植物认识和利用也有悠久的历史。我国早在公元前 600 ~ 1 000 年出版的《诗经》中就有“鬳”的记载。“鬳”（音 yi 或 ni）即今天兰科的绶草（*Spiranthes sinensis*（Pers.）Ames）（Chen and Tang, 1982; Chen, 1984; 1988b）。这应是全世界有关兰科植物的最早记载。石斛（*Dendrobium* spp.）、天麻（*Gastrodia elata* Bl.）和白及（*Bletilla* spp.）是兰科中传统的药用植物，最早见于东汉的《神农本草经》（25 ~ 220 A. D.）（Chen, 1984; 1988b）。在其后出版的本草药书中均有转载。在公元 659 年出版的唐《新修本草》中还首次附有木刻图。可惜此书早已亡佚。今天看到的最早木刻图为宋朝的《证类本草》（1083）。

在兰科中栽培历史最悠久的是兰属（*Cymbidium*）植物。我国对兰花的栽培与观赏的历史，大致始于唐朝后期，即公元 860 ~ 890 年之间（Chen, 1988b; Chen and Tsi, 1998）。在此之前古人虽然留下了大量咏兰、颂兰的诗词歌赋，但推敲起来并非真

正的兰花，而是指可用来熏蒸、杀虫、沐浴、辟邪的唇形花科或菊科植物，诸如藿香、泽兰、零陵香等花叶皆香的植物。

据目前所知，我国最早的兰花专著是南宋末年的赵时庚的《金漳兰谱》(1233)和王贵学的《兰谱》(1247)。这或许也是世界上最早的兰花栽培专著。兰花绘画也大致始于北宋时期，据记载，当时的宇画家任谊与米芾曾有画兰，但未有传世之作。而今日流传下来的最早兰花画卷应为北宋(960～1126)宫廷的蕙兰水彩工笔纨扇画(Chen and Tsi, 1998)。其次是南宋末年至元代初年赵孟坚(1199～1264)和郑思肖(1241～1318)的春兰纸本墨画(Chen and Tang, 1982; Chen, 1984; Chen and Tsi, 1998)。

应当说，经过比较深入细微的研究与分析，对于我国古代兰花观赏与栽培历史已经有了比较清晰的轮廓。只是在唐末仍存在一些疑点。例如从李白(701～762)和白居易(772～846)的诗中可以肯定，所指的"兰"并非真正的兰花，而与李白几乎同年的王维(701～761)却有"以黄磁斗贮兰蕙，养以绮石"的记载(Wu, 1996)。看来当时也有可能已有零星或局部的栽培兰花了。对于这一段历史作进一步的考证是必要的。

2 分类与系统

兰科分类研究自1925年开始至《中国植物志》(Lang *et al.*, 1999; Chen *et al.*, 1999b; Tsi *et al.*, 1999)正式出版，历时74年。

由于兰科植物大多数为热带树上附生植物，生境特殊，个体稀少，标本资料严重不足。而且，兰科植物花的结构复杂，色泽多变，在干标本上所能得到的信息是很有限的。因此，分类与系统研究的首要任务是补充文献资料和进行野外采集和考察。此项工作在1959年提出编写《中国植物志》后，特别是上世纪70年代后期开始，就积极进行了。通过坚持不懈的努力，一方面采集了大量的腊叶标本和泡花标本，并拍摄了近万张彩色照片；另一方面在唐进和汪发缵的研究基础上，又多次赴欧洲、美国、日本的有关机构核对标本，并将保藏于日本东京大学的台湾兰科模式标本全部拍摄带回；还两度赴台湾进行研究。从而保证了《中国植物志》(17～19卷)和有关专著中，对于名称鉴定、文献考订、形态描述、生境幅度、地理分布、物候期等方面的记述较为精确，并含有大量的第一手资料。

中国兰科植物的数量仅次于巴西与印度尼西亚，而与泰国、马来西亚、越南、印度等国相近。后几个国家也出版了类似《植物志》的兰科专著，但其野外第一手资料是明显不足的。目前世界上只有美国、日本和欧洲的少数国家出版了含有丰富野外第一手资料的兰科专著，但种类少(仅200～300种)，只有我们的1/4～1/6。我们除出版了三卷《中国植物志》外，还完成了多部专著(Wu, 1980; Yang *et al.*, 1993; Tsi *et al.*, 1997; Chen and Tsi, 1998; Chen *et al.*, 1999a)以及发表了大量的论文(Wu and Chen, 1966; 1980; Chen, 1981; 1982b; 1983c; 1985; 1987; 1988a; Chen and Lang, 1986b; Chen and Liu, 2003; Chen and Luo, 2002b; 2002c; Chen and Tsi, 1984a; 1992; Chen and Zhu, 1999; Chen *et al.*, 2001; Cheng and Tang, 1984; 1986a; 1986b; Cribb and Chen, 1999; Jin *et al.*, 2002; Lang, 1984; 1987a; 1989; 1992; 1996a; 1996c; Lang and Siu, 2002; Lang and Tsi, 1978; 1992; Liu, 1988; Liu and Chen, 1983; Liu and Chen, 2000a; 2000b; 2001; Liu and Zhang, 2000; 2001; 2002; Liu *et al.*, 2000; 2002a; 2002b; Qian, 2001; Tang and Cheng, 1981; 1982; 1984; 1985; 1986; Tsi, 1981a; 1981b; 1982a; 1984; 1985; 1989a; 1990; 1995a; 1995b; 1997a; Tsi and Chen, 1994; 1995b; Tsi and Ma, 1985; Tsi *et al.*, 1995; Wu and Chen, 1966; 1980; Wu and Liu, 1990; Zhang *et al.*, 2001; Zhu and Chen, 1998)。其中《中国野生兰科植物彩色图鉴》(Chen *et al.*, 1999a)受到国际的高度评价。

经过74年三代人的努力，中国兰科植物资源已基本弄清楚了，亦即共有野生种1 247个，归属于171属。其中由中国植物学家发现或命名的共有9个属：风兰属(*Neofinetia*)(Hu, 1925)、独花兰属(*Changnienia*)(Chien, 1935)、长喙兰属(*Tsaiorchis*)(Tang and Wang, 1936)、反唇兰属(*Smithorchis*)(Tang and Wang, 1936)、金佛山兰属(*Tangtsinia*)(Chen, 1965)、双蕊兰属(*Diplandrorchis*)(Chen, 1979b)和象鼻兰属(*Nothodoritis*)(Tsi, 1989b)，以及约200个新种和新变种，约占国产兰科全部种数的1/6。其中有些新种被认为是学术上的重大发现，如麻栗坡兜兰(*Paphiopedilum malipoense*)(Chen and Tsi, 1984b)与暖地杓兰(*Cypripedium subtropicum*)(Chen and Lang, 1986a)等被国外学术刊物全文转载并译成英文与德文，杏黄兜兰(*Paphiopedilum armeniacum*)(Chen and Liu, 1982)则多次获国际花展和兰展的金奖和一级证书(FCC)等最高奖。

值得注意的是台湾省兰科植物的研究也取得了很大的进展，出版了《台湾兰科植物》(3卷)(Lin, 1975; 1977; 1987)、《台湾植物志》(兰科)(Liu and Su, 1978; Su, 2000)、《台湾兰科植物彩色图鉴》(Ying, 1977 ~ 1990)、《台湾兰科植物彩色图志》(Ying, 1996)以及许多论文(Lin, 1975; Liu and Su, 1969; 1971a; 1971b; 1972 ~ 1975; Su, 1977; 1987; 1988)。此外，中国兰科植物分类与系统的研究也受到海外华人学者的重视，例如胡秀英(Hu, 1970; 1971a; 1971b; 1971 ~ 1975; 1977a; 1977b)。她对中国兰科文献和香港兰科的研究，是很有价值的。对于香港的兰科植物，G. Barretto 也协助胡秀英做了不少工作(Barretto, 1988; 1990)。

除编研专志外，在系统与属的专论性研究方面所涉及的面也比较广，较为重要的有科与亚族方面的系统(Chen, 1982a; Chen *et al*., 1999c)、原始蕊柱的结构与进化(Chen, 1965; 1979b; 1979c)、兰属(*Cymbidium*)(Wu and Chen, 1980)、曲唇兰(*Panisea*)(Chen, 1980)、石斛属(*Dendrobium*)(Tsi, 1980)、红门兰属(*Orchis*)(Tang *et al*., 1980)、无柱兰属(*Amitostigma*)(Tang *et al*., 1982)、槽舌兰属(*Holcoglossum*)(Tsi, 1982b)、天麻属(*Gastrodia*)(Chow and Chen, 1983)、盆距兰属(*Gastrochilus*)(Tsi, 1983; 1997b)、杓兰属(*Cypripedium*)(Chen and Xi, 1987)、阔蕊兰属(*Peristylus*)(Lang, 1987b)、角盘兰属(*Herminium*)(Lang, 1988)、金石斛属(*Flickingeria*)(Tsi and Chen, 1995a)、兜蕊兰属(*Androcorys*)(Lang, 1996b)、尖囊兰属(*Kingidium*)(Tsi, 1997c)、兜被兰属(*Neottianthe*)(Lang *et al*., 1997)、无喙兰属(*Holopogon*)(Chen, 1979c; 1997)、独蒜兰属(*Pleione*)命名系统(Zhu and Chen, 1998)、舌喙兰属(*Hemipilia*)(Luo, 2001)、虎舌兰属(*Epipogium*)(Luo and Chen, 2002)、火烧兰属(*Epipactis*)(Chen and Luo, 2002a; 2002d)等。主要对象是中国特有属、亚特有属或有丰富种类的属，全部是结合《中国植物志》的编研任务的。其中出现在无喙兰属与鸟巢兰属(*Neottia*)中的蕊柱变化式样在兰科中是独一无二的，对于阐明兰科的蕊柱进化是极好的例证。有趣的是锡金无喙兰(*Holopogon pantlingii* (W. W. Smith) S. C. Chen)与叉唇无喙兰(*H. smithiana* (Schltr.) S. C. Chen)既具有极其原始的蕊柱，又有特化的2裂唇瓣，其蕊柱稍向唇瓣弯曲，顶生柱头起到了与侧生柱头同样的作用。这是用"返祖现象"或"异常整齐花现象(Peloria)"所无法解释的(Chen and Tsi, 1987)。

综观上述，我们对兰科分类与系统的研究主要是以经典性为主的。这是在长期积累和丰富的野外工作基础上进行的，因而取得较明显成绩。《中国兰科植物研究》(陈心启、郎楷永、吉占和、罗毅波和朱光华)获2001年中国科学院自然科学一等奖和2002年国家自然科学二等奖。

诚然，这方面的研究今后仍然有广阔的前景，特别是中国有丰富的特有分类群(族、亚族、属等)。未来应当更多地利用新鲜材料，深入解剖花的细微结构，并在此基础上采用多学科综合研究，更重视微观形态与分子水平的研究，以取得更好的成果。

3　植物区系与地理

兰科是一个特殊的植物群，对生境的要求较为严格。研究其分布规律对于阐明植物区系与地理上的某些问题，具有独特的意义。我国在这方面的研究始于上个世纪80年代，大多数是地区性或某山系的，如西藏(Lang, 1980; 1981)、四川峨眉山(Lang, 1983a)、云南玉龙山(Lang, 1983b)、四川嘎贡山(Lang, 1985)、内蒙古(Gong and Ma, 1985)、四川卧龙自然保护区(Lang, 1986)、横断山地区(Lang, 1990)、贵州梵净山(Tsi, 1993)、云南西双版纳(Chen and Tsi, 1996)、台湾(Chen, 1998)等，也有全国性的或科、属、种方面的(Chen and Tang, 1982; Chen, 1983a; Lang, 1994)。其中比较重要的有：(1)界定石上附生兰，如蜈蚣兰(*Cleisostoma scolopendrifolium*)(Makino) Garay、瘦房兰(*Ischnogyne mandarinorum* (Kraenzl.) Schltr.)、独蒜兰(*Pleione bulbocodioides* (Franch.) Rolfe)、小羊耳蒜(*Liparis fargesii* Finet)、细叶石斛(*Dendrobium hancockii* Rolfe)等的分布北界与西界，它与中国亚热带的北界相一致(亦即沿青藏高原南坡至秦岭南坡到淮河一线)(Chen and Tang, 1982)。(2)根据杓兰属(*Cypripedium*)、对叶兰属(*Listera*)、朱兰属(*Pogonia*)、舌唇兰属(*Platanthera*)、筒距兰属(*Tipularia*)等间断分布式样，阐述了中国与北美东部兰科植物区系的亲缘性(Chen, 1983a; 1983b)。(3)根据紫茎兰属(*Risleya*)、合柱兰属(*Diplomeris*)、尖药兰属(*Diphylax*)和舌唇兰属(*Platanthera*)的显柱舌唇兰亚属(subgen. Stigneatosa)(Lang, 1998)、风兰属(*Neofinetia*)、旗唇兰属(*Vexillabium*)、萼脊兰属(*Sedirea*)的分布，提出了东亚植物区中的中国－喜马拉雅植物亚区与中国－日本植物亚区在四川境内的分界线(以峨眉山与岷江为分界线，即从南坪九寨沟、经峨眉山至攀枝花一线(Lang,

1994)。(4)分析云南南部西双版纳的兰科植物区系,并与海南、台湾、老挝、柬埔寨、越南、泰国等兰科植物区系相比较,提出了热带性的指标:即在某一地区的兰科植物区系中若附生属占50%或单轴系的属占30%以上的,可以认为是热带植物区系(Chen and Tsi, 1998)。(5)对台湾与亚洲大陆兰科植物区系进行比较,认为台湾应划归古热带植物区的马来亚森林植物亚区(Chen and Lang, 1998; Chen, 1998)。其中,兰科在四川西部的分界线,被认为是划分中国喜马拉雅植物亚区与中国-日本植物亚区的科学分界线,与根据芸香科在云南境内划出的分界线合称田中-楷永线(Li and Li, 1998)。

目前,国内关于植物区系与地理的论著甚多,但大多数为一般性的植物区系成分比较与分析或属、种分布区的标定,较少与生态、系统、进化、遗传、地史等研究相结合。兰科在这方面的研究也不例外,有待于深化,特别是应重视与其他学科相结合。兰科作为一个对生境要求较为苛刻和敏感的植物群,深入地研究其植物区系与地理,会有其难以替代的作用。

4 微观形态

我国学者对兰科微观形态的研究起步较晚,大多数论著发表于自上世纪80年代以后。细胞学方面主要为染色体数目与核型的报道。自1984年以来,大约有石斛属(*Dendrobium*)、兰属(*Cymbidium*)、天麻属(*Gastroia*)、白及属(*Bletilla*)、万代兰属(*Vanda*)、独蒜兰属(*Pleione*)、槽舌兰属(*Holcoglossum*)、鹤顶兰属(*Phaius*)、火焰兰属(*Renanthera*)、贝母兰属(*Coelogyne*)等约30属120种被观察过(Liang, 1984; Yang and Zhu, 1984; 1989; Cheng *et al*., 1985; Li and Chen, 1987; Wang and Xu, 1989; Zeng *et al*., 2001)。主要是药用或观赏种类,其中90%以上为国产种类,也包括少数国外野生种,如树兰属(*Epidendrum*)、卡特兰属(*Cattleya*)和文心兰属(*Oncidium*)的个别种类。

孢粉学方面大多仅观察花粉外部形态,仅杓兰属(*Cypripedium*)研究了外壁超微结构。总共约20属50种被研究过,包括内蒙古产的舌唇兰属(*Platanthera*)和红门兰属(*Orchis*)等10余属(Gong, 1986),杓兰属(Chen and Xi, 1987; Xi and Chen, 1991)、兜被兰属(*Neottianthe*)(Xi *et al*., 1998)、手参属(*Gymnadenia*)(Xi *et al*., 2000)等。后三个属主要分布于我国,孢粉学研究全部是结合分类系统进行的。

解剖学方面主要是营养器官和叶表皮微形态研究。营养器官(根、茎、叶)研究主要集中于石斛属(*Dendrobium*)(Zhang and Zhai, 1995; Zhang *et al*., 2001; Li, 2002)、兰属(*Cymbidium*)(Ye *et al*., 1992; Yang *et al*., 1995; Li *et al*., 2000; 2002)和香荚兰属(*Vanilla*)(Zhao and Wei, 1999)等有重要经济价值的属。叶表皮微形态研究则包括了兰属(*Cymbidium*)、兜兰属(*Paphiopedilum*)、石斛属(*Dendrobium*)(Sun, 1995)和兜被兰属(*Neottianthe*)(Sun *et al*., 1999)等。只有6个属40余种被研究过,大多数是国产种类,也包括了个别引种栽培的大花惠兰和香荚兰等。

胚胎学研究是上个世纪90年代才开始的。目前已知有黑节草(*Dendrobium officinale* Kimura et Migo)(Xu *et al*., 1995)、墨兰(*Cymbidium sinense* (Jacks. ex Andr.) Willd.)(Yeung *et al*., 1994; 1996; Xu and Ye, 1995; Ye and Guo, 1995; Huang *et al*., 1998; Tung *et al*., 1999; Zee and Ye, 1995)、金线莲(*Anoectochilus roxburghii* (Wall.) Lindl.)(Zhang *et al*., 1996)、五唇兰(*Doritis palcherrima* Lindl.)(Tang *et al*., 1998)、鹤顶兰(*Phaius tankervilleae* (Banks ex L'Herit.) Blume)(Ye *et al*., 1996; 1997; 2002; Tung *et al*., 2000)等5种被研究过。内容包括大小孢子发生与雌雄配子体发育、受精过程与胚胎发育等方面。兰科种子微小,数量巨大,没有胚乳,但双受精过程正常。没有胚乳是由于初生胚乳核在分裂若干次后消失所致。胚胎学的比较研究,包括胚乳核的分裂次数和种子数量的关系,以及在不同类群中的情况等,在系统发育上是颇有意义的。

生理学研究主要集中于墨兰(*Cymbidium sinense*),由潘瑞炽等人发表了多篇论著(Pan and Liang, 1988; Ye *et al*., 1992; 1993; Pan and Chen, 1994),也有少数文章涉及石斛属(*Dendrobium*)的种类(Xu *et al*., 1993; Chou *et al*., 2001)。

此外,还有植物化学(Chou *et al*., 1983)、形态发生(Yang, 1982; Weng *et al*., 2002)、生理生态(Gou *et al*., 2003)以及生化方面的研究(Liu, 1982; Xu *et al*., 1993; Shu *et al*., 1995; Liu *et al*., 2001; Zhang *et al*., 2002; Sun *et al*., 2002)。

应当说,中国兰科植物有很多的特有属、种,研究材料十分丰富。而微观形态与系统发育、进化、昆虫传粉均有密切的关系。例如从花微观形态发生的角度研究扇唇舌喙兰(*Hemipilia flabellate* Bur. et

Franch.)的传粉(Luo and Chen, 1999)以及兰亚族(Orchidinae)中某些代表种类的花的发育(Luo and Chen, 2000)等,对于深入了解花的进化及其与昆虫之间的适应辐射是很有启发性的。

5 栽培与繁殖

我国兰科植物的栽培与繁殖首先从有经济价值的种类开始,特别是天麻、石斛类和国兰。兹分述如下:

5.1 组织培养与种子繁殖

兰花的组织培养和种子繁殖在大多数属和种中均已成功。兜兰属(*Paphiopedilum*)虽然组织培养尚未成功,但种子繁殖在国产的许多种类中亦无问题。据作者所知,在中国科学院植物研究所、中国科学院华南植物研究所、北京华乐种苗公司、中国科学院昆明植物研究所、中国科学院上海植物生理研究所、华南师范大学生物系、四川大学生物系、林业科学院热带林业研究所、四川省农业科学院、广东省农业科学院、深圳市农科中心、海南大学农学院、云南英茂生物技术实验室等以及许多兰花企业均已有大量兰花组培苗或种子苗生产。所涉及的属很多,主要为兰属(*Cymbidium*)(Wang *et al*., 1981; Wang, 1984; Duan and Xie, 1982; Wang *et al*., 1988; He *et al*., 1994; Zee and Ye, 1994; Ye, 1995)、石斛属(*Dendrobium*)(Hu and He, 1979; Ye *et al*., 1988; Wang *et al*., 1995; 1999; Xu *et al*., 2001;)、天麻属(*Gastrodia*)(Liu, 1996)、开唇兰属(*Anoectochilus*)(Wang, 1995; Chen *et al*., 1998; He *et al*., 1999)、苞舌兰属(*Spathoglottis*)(Chen, 1997)、五唇兰属(*Doritis*)(Zhang *et al*., 1995)等的一些野生种,以及引种的香荚兰属(*Vanilla*)(Duan and Hu, 1989; Lan *et al*., 1994)、蝴蝶兰属(*Phalaenopsis*)(Jin, 1994; Yang *et al*., 2000; Zeng *et al*., 2000; Chen *et al*., 2003)、树兰属(*Epidendrum*)(Zeng *et al*., 1996)等栽培杂交种。

5.2 杂交育种

目前国内杂交育种方面在一些属已经获得成功。中国科学院昆明植物研究所、中国科学院华南植物研究所、四川省农业科学院等单位已育成许多杂种,涉及兜兰属(*Paphiopedilum*)、兰属(*Cymbidium*)、鹤顶兰属(*Phaius*)和虾脊兰属(*Calanthe*)等。有些已在国际上登录,但未推向市场。此项工作起步晚,严重滞后,今后应成为重中之重。主要目标是面向市场,选育出有商业价值的新品种,大力繁殖,以满足国内外需要。

5.3 兰属植物培养

兰属(*Cymbidium*)是我国传统的观赏植物,又称国兰,主要是指春兰(*Cymbidium goeringii* (Rchb. f.) Rchb. f.)、蕙兰(*C. faberi* Rolfe)、建兰(*C. ensifolium* (L.) Sw.)、墨兰(*C. sinense* (Jacks. ex Andr.) Willd.)、寒兰(*C. kanran* Makino)、莲瓣兰(*C. tortisepalum* Fuk.)和春剑(*C. tortisepalum* var. *longibracteatum* (Wu et Chen) Chen et Liu)等七大系列。此类兰花在我国拥有数以百万计的爱好者,是兰花产业的重要组成部分。关于品种、分类、栽培、繁殖、病虫害防治等已出版了大量的著作(Wu and Chen, 1980; Wu, 1980; Pan, 1988; Sun *et al*., 1989; Chen and Tsi, 1998; Liu, 1998; 2003; Yan, 2001)。国兰在南方许多省市进行了大量栽培与繁殖试验,已形成规模生产,并出口到韩国和日本。其中深圳市梧桐山苗圃总场的"国兰新品种培育、商品化生产和花叶艺变异的研究(刘仲健等)"获深圳市 2002 年科技进步一等奖。目前存在的主要问题是新品种培育的工作滞后,因为繁育周期长、难度大,愿意投入者甚少。

5.4 其他兰花培养

主要包括蝴蝶兰系列(*Phalaenopsis* hybrids)、大花蕙兰系列(*Cymbidium* hybrids)和石斛系列(*Dendrobium* hybrids)的观赏或药用品种,已出版了一些论著(Lu, 1994; Chen and Tsi, 1998; Li, 1999)。药用石斛的栽培在浙江与云南已形成一定的规模。石斛生药学的研究已发表了大量的论著(Bao *et al*., 2001)。目前国内市场上观赏兰花的品种大多为国外流入。国内的一些单位,如深圳农科中心、北京华乐种苗公司、广东农科院花卉研究所、云南英茂生物技术实验室等也正在进行杂交育种实验,只有极少数蝴蝶兰、石斛和大花蕙兰品种进入市场。但在名贵品种引种栽培与试管繁殖方面已取得显著的成绩。深圳市农科中心的"名贵兰花引种(刘荣维等)"获深圳市 2001 年科技进步一等奖。引种与杂交工作在花卉产业中均占极重要的位置,有很好的市场前景与经济效益,值得大力发展。

5.5 天麻培养

天麻(*Gastrodia elata* Bl.)是我国传统的中药,已有约 2 000 年的应用历史。由于天麻为腐生草本,栽培难度较大,民间多直接挖掘野生植株供药用。早期利用天麻块茎就地进行人工栽培生产虽获成功,但存在严重的种质退化问题。我国学者在 20 世

纪70年代就开始致力于天麻有性繁殖和生物学特性方面的研究(Chow, 1974; Liu and Zhang, 1975)。随后又研究了天麻与蜜环菌的关系(Zhang and Li, 1980),并报道了天麻的生活史,提出天麻胚萌发时无需蜜环菌参与,但形成原生球茎后在不同的阶段对蜜环菌有不同的反应(Chow, 1981; Xu *et al.*, 1989),并从天麻种子发芽的原球茎中分离出12种影响种子发芽的有效菌株。其中较优良的一株,可使天麻种子发芽率达20%以上(Xu *et al.*, 1981)。经鉴定此菌株为紫萁小菇(*Mycena osmundicola* Lange)(Xu and Guo, 1989)。紫萁小菇的发现使得对天麻生活史的认识更加深入(Xu *et al.*, 1989)。毫无疑问,蜜环菌和紫萁小菇的发现,为我国天麻人工繁殖完全成功奠定了基础。此后,又发现小菇属(*Mycena*)的其他种类对天麻种子萌发均有促进作用(Fan and Guo, 1997; Guo and Fan, 1997; Guo *et al.*, 1999)。至此,一个更为完整的天麻生活史逐渐展现出来,即天麻先后需要多菌感染才能完成其生活史。在天麻种子胚萌动初期、种子发芽、原球茎生长以及分化出营养繁殖茎的全过程中,均需感染小菇属的菌类,而发芽后的原球茎及营养繁殖茎则需与蜜环菌建立营养供给关系,只有这样才能正常完成从种子到种子的生命周期。目前人工繁殖的天麻已能供应市场需要。存在的问题是,还不清楚在原位条件下,最先侵染天麻种子的真菌是哪一种或哪几种小菇属真菌,以及它们对天麻种子生长发育的具体作用。

6 共生真菌

兰科植物的种子非常细小,一个蒴果中有几万到上百万粒种子。由于种子内没有胚乳,仅有分化不完全的胚细胞,其种子萌发阶段完全依靠菌根真菌为其提供养分。兰科植物与真菌的共生,自上个世纪初法国的N. Bernard与德国的Burgeff发现以来,已经历了一个世纪。而我国有关这方面的研究始于20世纪70年代,是为解决天麻在自然条件下人工种植问题。如上所述,最初认为天麻自种胚萌发到块茎成熟,终生依靠分解入侵的蜜环菌类的菌丝为其主要营养,同时又认为与天麻共生的菌似乎不止一种菌(Chow, 1974)。后来,进一步对蜜环菌与天麻生长的关系进行更深入的研究,认识到天麻球茎在其生长发育过程中,与蜜环菌经历了拒菌阶段、控制阶段和开放阶段等3个阶段(Chow, 1981; Xu and Lan, 2001)。接着从天麻种子发芽的原球茎中分离出12种影响种子发芽的有效菌株。其中最重要的发现为分离出紫萁小菇(*Mycena osmundicola* Lange)(Xu and Guo, 1989)。此项研究不断深入,涉及了真菌在种子萌发阶段和原球茎形成阶段的侵染过程与影响,以及小菇属真菌与蜜环菌侵入同一营养繁殖茎后的相互关系等(Xu and Mou, 1990; Guo and Xu, 1990b; 1990c; Lan *et al.*, 1996; Fan *et al.*, 1999a; 1999b; Xu and Lan, 2001)。

更为重要的是,通过对天麻与共生真菌的研究建立了一套利用染菌树叶在100 lx光照下诱导担子菌形成子实体的实验方法(Xu and Guo, 1989)。结合Currah (1987)对不育菌丝群(Mycelium radices atrovires)诱导形成产胞结构的方法,成功地诱导大量菌株形成产胞结构或子实体,为菌株形态鉴定提供了可靠而稳定的特征。到目前为止,我国共有石斛属(*Dendrobium*)(Guo and Cao, 2000)、开唇兰属(*Anoectochilus*)(Guo and Fan, 1997)等20属44种兰科植物的内生真菌被不同程度地研究过(表1)。总共分离

表1 分离出真菌的兰科植物名录
Table 1 A list of orchids from which fungi were isolated

属名 Generic name	种数 Number of species	属名 Generic name	种数 Number of species
脆兰属 *Acampe*	1	毛兰属 *Eria*	1
指甲兰属 *Aerides*	1	天麻属 *Gastrodia*	1
开唇兰属 *Anoectochilus*	1	羊耳蒜属 *Liparis*	2
石豆兰属 *Bulbophyllum*	2	兜兰属 *Paphiopedilum*	3
卡特兰属 *Cattleya*	1	鹤顶兰属 *Phaius*	1
贝母兰属 *Coelogene*	1	蝴蝶兰属 *Phalaenopsis*	1
兰属 *Cymbidium*	9	苞舌兰属 *Spathoglottis*	1
石斛属 *Dendrobium*	10	万带兰属 *Vanda*	4
五唇兰属 *Doritis*	1	假万带兰属 *Vandopsis*	1
厚唇兰属 *Epigeneium*	1	香荚兰属 *Vanilla*	1

和鉴定出 13 个真菌属：*Ceratorhiza*、*Epulorhiza*、*Moniliopsis*（Fan and Guo, 1989）、*Fasarium*（Wu and Zheng, 1994）、*Mycena*（Fan *et al*., 1996; Guo *et al*., 1999）、*Cylindrocarpon*、*Myceliophthoreae*、*Cephalosporium*、*Ceratorhiza*、*Chromosporium*、*Rhizoctomia*、*Gloiocladium*、*Pestalotina*（Guo and Cao, 2000）。除具体研究工作之外，我国学者还十分关注国际上有关兰科植物与共生真菌相互作用的研究动态，结合我国研究状况，在不同时期发表了一些具有代表性的综述性文章（Guo and Xu, 1990a; Fan and Guo, 1998; Chen *et al*., 2003）。这些综述性文章对我国有关研究中存在的不足以及今后努力的方向都提出很好的意见。我国目前有关兰科植物与菌根真菌共生关系的研究，主要采取两种方法：一是从兰科植株根的皮层细胞中分离菌根真菌；二是在异地人工条件下，利用兰科植物种子与各种菌根真菌进行共生萌发实验，探讨种子及原球茎与菌根真菌之间的关系，并进一步验证从皮层细胞所分离得到的真菌是否是真正的共生真菌。然而，这两种方法均不能揭示在自然条件下真菌对兰科植物种子萌发的诱导过程，也无法了解自然状况下是一种还是多种菌根真菌首先侵染到种子中。很有可能最先侵染的菌根真菌对兰科植物种子萌发和萌发后的生长发育影响最大（Fan and Guo, 1998）。因此，今后应注意利用原地种子萌发的方法，对当地原生兰科植物菌根中的真菌进行研究，以求取得更好的效果。

7　传粉生物学

兰科植物具有极高的物种多样性，甚至有人称之为“进化大爆炸”。这种快速进化的特点之一，就是其进化过程与传粉者密切相关。多数兰科植物具有防止近缘种杂交的机制，这种机制主要是由各种机械或生态因子形成的，如不同的传粉者，或同一传粉者花粉块附着位置的细微差异，以及不同的开花期等。因此，传粉生物学对研究兰科植物的进化和适应具有重要意义。但就总体而言，有关兰科植物传粉生物学的研究主要集中在欧洲和北美等地区的温带地生类群以及少数的中、南美洲热带附生类型，而在亚洲有关的研究资料则极为缺乏。我国仅对极少数种类进行过这方面的研究。例如发现鸟足兰（*Satyrium ciliatum* Lindl.）两性型与单性型花并存，且在两者之间具有一系列过渡类型，最简化的雌性型只具 1 个直立的花柱与三裂的柱头以及 3～4 个近同形的花被片（Chen, 1979）。后来虽到野外进行数周的观察，因地势险峻，难度大，无功而返。近年开展的对舌喙兰（*Hemipilia flabellate* Bur. et Franch.）的传粉机制的研究，首次发现了该种利用食源性欺骗传粉方式引诱芒康条蜂（*Anthophora mangkamensis* Wu）为其进行传粉（Luo and Chen, 1999），而真正提供花蜜的是唇形花科的痢止蒿（*Ajuga forrestii* Diels）。两者的花颇为相似，但后者数量较少。这是亚洲兰花传粉生物学领域首次报道这种现象。另一例是对独花兰（*Changnienia amoena* Chien）进行的传粉生物学定点观察，发现雌性三条熊蜂（*Bombus* (*Diversobombus*) *trifasciatus* Smith）、仿熊蜂（*Bombus* (*Tricornibombus*) *imitator* Pittion）和蜜蜂均访问独花兰，但只有三条熊蜂身体粘有花粉块，是独花兰的有效传粉者，并推测独花兰也是一种欺骗性传粉的兰花（Sun *et al*., 2003）。

显然，上述少数几例研究与我国丰富的兰科植物相比是极不相称的。因此广泛开展传粉生物学研究，尽可能多地了解中国兰科植物类群的传粉式样和传粉机制是今后相当长时期内的重要任务。与此同时，我们还要注意将兰科传粉生物学研究与居群生物学研究相结合，来探讨兰科植物的花粉流、基因流方向和范围；将传粉生物学研究与系统学研究相结合，以了解特定类群或特定区域内兰科植物的进化过程和适应辐射特点。

8　保护生物学

兰科植物具有复杂的生活史，一方面，它需要特定的真菌来帮助其种子进行萌发，另一方面，兰科植物需要特定的传粉者来帮助其实现受精。正因如此，兰科植物对生态环境的影响非常敏感，特别需要人类的保护，同时我们也可以利用兰科植物的生长或生存状况来指示生态环境的变化。兰科植物多为珍稀濒危植物，全世界所有野生兰科植物均被列入《野生动植物濒危物种国际贸易公约》的保护范围，占该公约应保护植物的 90% 以上，是植物保护中的“旗舰”类群（flag group）。我国对兰科植物的保护工作开展较晚，在 1987 年出版的“中国珍稀濒危植物名录”（Anonymous, 1987）中仅列入了蝴蝶兰（*Phalaenopsis aphrodite* Rchb. f.）、无喙兰（*Archineottia* (= *Holopogon*) *gaudissartii* (Hand.-Mzt.) S. C. Chen）、独花兰（*Changnienia amoena* Chien）和金佛山兰（*Tangtsinia nanchuanica* S. C. Chen）等 4 种兰科植物（Anonymous, 1987）；后来 1992 年在《中国植物红皮书》第一卷中兰科植物种类增加到 7 种。此后，我国

学者对列入红皮书中的独花兰(*Changnienia amoena*)、金佛山兰(*Tangtsinia nanchuanica*)以及硬叶兜兰(*Paphiopedilum micranthum* Tang et Wang)等的濒危现状、原因、生物学特性、保护措施以及保护遗传学等方面开展了一些工作(Cribb and Luo, 1998; 1999; Tsi *et al*., 1999; Cribb *et al*., 1998; 1999a; 1999b; 1999c; 1999d; 2001; 2002; Li and Chen, 2002; Li *et al*., 2002; 2002a; 2002b; Guo *et al*., 2003; Sun *et al*., 2003);也对大花杓兰(*Cypripedium macrathum* Sw.)的濒危机制进行了初步探讨(Liu *et al*., 1998)。中国兰科植物保护工作早已受到国际的关注。早在1996年陈心启就应邀在亚太兰花国际会议大会上作中国兰科植物保护现状的报告(Chen, 1996a),并应IUCN兰花专家组的邀请,就东北亚地区兰科植物保护的现状、存在的问题和急需采取的措施进行了探讨(Chen, 1996b)。目前在我国,兰花的原地保护与迁地保护均处于起步阶段。各地已建立一些迁地保护的园地,如中国科学院西双版纳热带植物园(热带兰)、深圳市梧桐山苗圃总场(兜兰属与兰属为主)、中国科学院昆明植物研究所(热带兰为主)、中国林业科学院热带林业研究所海南尖峰岭试验站(热带兰)、无锡鼋头渚公园(兰属为主)、云南英茂生物技术试验室(石斛为主)等。当务之急是应由国家林业局统一规划与领导,加强保育生物学的研究,提高繁育和回归自然的能力,避免盲目引种野生种,造成资源的破坏。看来全面启动中国兰科植物保护工作已刻不容缓。近来罗毅波等人还就我国有关兰科植物保护的基础研究工作做了一个较为全面的回顾,并针对我国现状提出了今后的重点发展方向(Luo *et al*., 2003)。

诚然,如何采取有效的保育措施来保护这些受威胁的兰科植物不仅取决于教育与经济发展,还必须对兰科植物自身有一个全面深刻的认识,需要进行生态学、居群生物学、生物学特性、栽培和繁殖生物学等各个学科的综合研究。以北美为例,在对一种本土兰科植物采取保护措施之前,需委托有关专家提出内容全面的建议书。相比之下,我国在有关兰科植物保护方面所开展的研究还远未达到全面深刻认识所要保护植物的水平。当然,这种全面的基础研究由于受各方面因素的限制,只能在一些最重要的保护类群中才能开展。因此,集中有限的力量对最重要的类群进行全面研究是十分必要的。

总之,我国兰科研究自20世纪20年代开始至今已取得了长足的进步。展望未来,主要的目标是开展对特有或亚特有属,或是主要分布于我国的分类群进行进一步综合性的学术研究和对有重要观赏和药用价值的分类群作应用研究。其中最重要的属有兜兰属(*Paphiopedilum*)、杓兰属(*Cypripedium*)、兰属(*Cymbidium*)、独蒜兰属(*Pleione*)、槽舌兰属(*Holcoglossum*)、开唇兰属(*Anoectochilus*)以及兰亚族(Orchidinae)中的一些属,如玉凤花属(*Habenaria*)和舌缘兰属(*Hemipilia*)等及一些外来的分类群等。当然,将来还需要更多的国际合作。

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