

### 附录 1 已报道的被子植物主要花粉颜色及其化学物质基础

#### Appendix 1 The main pollen colors and their chemical bases of angiosperms reported

花粉颜色	代表性类群	化学物质	参考文献
Pollen color	Representative taxon	Chemical compound	Reference
黄色 Yellow	豚草、菊科、仙客来、豌豆、百合属、罂粟科、矮牵牛属、杏、大马士革玫瑰、玉米、蒺藜科 <i>Ambrosia artemisiifolia</i> , Compositae, <i>Cyclamen persicum</i> , <i>Lathyrus oleraceus</i> , <i>Lilium</i> , Papaveraceae, <i>Petunia</i> , <i>Prunus armeniaca</i> , <i>Rosa × damascena</i> , <i>Zea mays</i> , Zygophyllaceae	8-甲氧基山柰酚-3-槐糖苷、2',4',6',4-四羟基查尔酮、异鼠李素苷元、类胡萝卜素、山柰酚、槲皮素、黄色黏附油性物质 8-methoxykaempferol 3-sophoroside, 2',4',6',4-tetrahydroxychalcone, Aglycone isorhamnetin, Carotenoids, Kaempferol, Quercitin, Yellow surface oils	Heyl, 1919; Heslop-Harrison, 1968b; Stanley & Linskens, 1974; Ceska & Styles, 1984; Wiering et al, 1984; Ferreres et al, 1989
橙色 Orange	加州罂粟、向日葵属植物、豌豆、百合属 <i>Eschscholzia californica</i> , <i>Helianthus</i> , <i>Lathyrus oleraceus</i> , <i>Lilium</i>	类胡萝卜素、隐黄素、毛茛黄素、叶黄素酯、山柰酚、叶黄素、 $\alpha$ -和 $\beta$ -胡萝卜素 Carotenoids, Cryptoxanthin, Flavoxanthin, Lutein esters, Kaempferol, Xanthophylls, $\alpha$ - and $\beta$ -carotene	Heslop-Harrison, 1968b; Coe et al, 1981; Wakelin et al, 2003; Barrell et al, 2010; Fambrini et al, 2010; Bertoli et al, 2011
棕色 Brown	美洲风铃草、百合属 <i>Campanula americana</i> , <i>Lilium</i>	类胡萝卜素、木犀草素 Carotenoids, Luteolin	Heslop-Harrison, 1968b; Koski et al, 2020
蓝色 Blue	欧洲银莲花、矮牵牛属 <i>Anemone coronaria</i> , <i>Prunus armeniaca</i>	花青素：飞燕草素、飞燕草素-3-阿拉伯糖苷、矮牵牛素苷 Delphinidin, Delphinidin-3-arabinoside, Petunidin glycosides	Wiering et al, 1984; Webby & Bloor, 2000
绿色 Green	矮牵牛属 <i>Prunus armeniaca</i>	花青素：飞燕草素、飞燕草素-3-阿拉伯糖苷、矮牵牛素苷，查尔酮 Anthocyanins: Delphinidin, Delphinidin-3-arabinoside, Petunidin glycosides, and the Chalcone.	Wiering et al, 1984
紫红色 Amaranth	挂金钟属 <i>Fuchsia</i>	飞燕草素-3-O-(对-顺-香豆酰-葡萄糖苷)、飞燕草素的对-反式-香豆酰化衍生物、矮牵牛配基、锦葵色素-3-O-葡萄糖苷 Delphinidin-3-O-(p-cis-coumaroyl-glucoside), P-trans-coumaroylated derivatives of Delphinidin, Malvidin-3-O-glucosides, Petunidin	Webby & Bloor, 2000
紫色 Purple	美洲风铃草 <i>Campanula americana</i>	矢车菊素、芍药苷 Cyanidin, Peonidin	Koski et al, 2020
乳白色或灰白色 Milky or off-white	美洲风铃草 <i>Campanula americana</i>	黄酮(高浓度) Flavone with high concentration	Koski et al, 2020

## 附录 2 常见的花粉颜色测量方法

### Appendix 2 The general methods for pollen color measurement

方法 Method	原理 Technique	仪器设备 Device or equipment	优点 Advantage	缺点 Weakness	来源或文献引用 Origin or reference
色卡比对 Color card comparison	在暗室内专门测色的灯下, 对玻片上的静置花粉利用 Ridgway color 系统色卡、潘通、蒙赛尔或 RHS 比色卡比出花粉颜色 The color of pollen grains on the slide is evaluated by the Ridgway colourimetric cards, Pantone, Munsell FM or RHS Chart) under a special color-measuring lamp in a dark room	无 None	①不依赖仪器设备 ②可编号、便于查询并分类统计 ③可规范描述某种颜色 ①Independent of device and equipment ②Can be numbered, and easy to query and classified for statistics ③Can be used to describe certain color by a criterion	①会因电子产品分辨率不同而产生色差 ②依靠主观判断, 误差大 ①Cause the Color difference by using electronic products with various resolution. ②Measured by human vision with larger errors	Ferguson, 1927
水彩记录 Watercolor record	在北欧天空自然光(色温 6500K)的白色背景下, 在白色卡片上用水彩画绘出花粉颜色 The color of pollen grains is drawn with Watercolor on white cards against a white background of the natural light of the Nordic sky, with color temperature as 6500K	无 None	①不依赖仪器设备 ②简单快捷 ①Independent of device and equipment ② Simple and quick	①需要绘画技巧 ②环境因素可控性低 ③易褪色难保存, 持久性差 ④依靠主观判断, 误差大 ①Require painting skills ② Low controllability of environmental factors ③Be Easily faded, and difficult to preserve and persist in a long time ④Measured by human vision with larger errors	Kirk, 1994
四色印刷 Four-color printing	基于四种颜色的油墨, 通过四色印刷过程中使用的 CMYK 值直接指定颜色 By using four-color inks, the color of pollen grains is identified directly through the CMYK value generated in the four-color printing process	无 None	①不依赖仪器设备 ②颜色信息可被数字化 ① Independent of device and equipment ②Color information can be digitalized	①不能呈现所有颜色 ②易褪色难保存, 持久性差 ③依靠主观判断, 误差大 ① Cannot reproduce large-scale colors ②Be Easily faded, and difficult to preserve and persist in a long time ③Measured by human vision with larger errors	Kirk, 1994
图像颜色数字化 Image color digitization	在统一标准环境下拍摄花粉图像, 利用在线或离线网络图像颜色数字化工具, 提取颜色数据 The image of pollen grains is taken under unified standard environmental factors, and the color data	照相机、显微镜及其成像系统 Camera, microscope and its imaging system	①简单方便 ②不依赖视觉感官 ③可识别任何颜色并将其转换为数字格式, 便于分析	①对摄像技术要求高 ②只能对比分析统一标准环境下拍摄的一组图像 ① stricter requirements for camera	在线分析网站如: Adobe Color CC、Canva Color Palette Generator、Pictaculous、Paletton

方法 Method	原理 Technique	仪器设备 Device or equipment	优点 Advantage	缺点 Weakness	来源或文献引用 Origin or reference
	are extracted using online or offline network image color digitization tools		①Simple and convenient ②Independent of human vision ③Can identify any color and convert it into a digital format for analysis	technology ② Only a group of images taken under unified standard environmental factors can be compared and analyzed	Online software platforms: such as Adobe Color CC, Canva Color Palette Generator, Pictaculous and Paletton
光学设备采集数据比色 Colorimetry of data collected by optical devices	利用电子扫描显微镜(SEM)、立体显微镜、数码相机对花粉图像和颜色分析, 运用相关软件获得花粉的颜色参数(如 CIE L*a*b*/RGB 相关数值等) Using scanning electron microscope (SEM), stereo microscope and digital microscope (camera) to analyze the pollen color in images, and using related softwares to obtain the color parameters of pollen (such as CIE L*a*b*/RGB related values, etc.)	电子扫描显微镜、立体显微镜、数码相机 Scanning electron microscope, stereoscopic microscope, digital microscope (camera)	①准确度高, 不依靠主观判断 ②量化颜色为数据, 有标准, 可永久保存, 便于分析 ③环境标准易制可控 ① High accuracy, and independent of human vision ② Quantize color into data by a criterion, and can be permanently saved for easily analysis ③ Environmental factors are easy to control	设备要求高, 搬动困难, 不利于在户外开展即时测量 The equipment has high requirements and is difficult to move for measurement outdoors when pollen grains are fresh	Bleha et al, 2021
光谱扫描 Spectral scanning	利用光谱设备, 测量花粉样品表面的光学性质, 如光的吸收、反射和荧光发射 Spectral equipment is used to measure the optical properties of the surface of pollen grains, such as light absorption, reflection and fluorescence emission	光谱仪(如单色仪, 配有光纤反射探头、SpectraSuite 光学显微软件平台), 显微分光光度计(带光源氙灯、检测器、高分辨率的 CCD 阵列式检测器) Spectrophotometer (e.g., monochromator, with fiber-optic reflection probe, SpectraSuite optical microscopy software platform), microspectrophotometer with xenon lamp, detector, and CCD array detector with high resolution	①获得多维、多元的原始颜色光谱信息 ②数据无损、精准、详细, 操作便捷, 检测快速, 便于分析和广泛使用 ① It can obtain multidimensional and multivariate original color spectrum data ② The data is lossless, accurate and detailed, and the device is easy to operate, quick to detect, easy to analyze and the data are widely used	仪器昂贵, 户外使用成本高 Devices are expensive and have high costs for outdoor use	徐彻等, 1991; 魏垂策等, 2009; 王思玲, 2017 <sup>1</sup> ; Xiong et al, 2019; 胡灿等, 2021 Xu et al, 1991; Wei et al, 2009; Wang et al, 2017; Xiong et al, 2019; Hu et al, 2021

<sup>1</sup> 王思玲 (2017) 基于色度模型的细胞显微图像颜色 评估方法及应用研究. 南昌航空大学, 南昌.

### 附录 3 基于 Fitch 简约法重建的花粉颜色演化式样中花粉颜色数据来源

#### Appendix 3 Data sources of the character optimization of pollen color and its evolutionary pattern based on Fitch parsimony

科	属	花粉颜色	文献来源
Family	Genus	Pollen color	Reference
菊科	向日葵属	橙色、黄色、白色	Fambrini M, Michelotti V, Pugliesi C (2010) Orange, yellow and white-cream: Inheritance of carotenoid-based colour in sunflower pollen. <i>Plant Biology</i> , 12, 197–205.
Asteraceae	<i>Helianthus</i>	Orange, yellow, white	
菊科	豚草属	黄色	Heyl FW (1919) The yellow coloring substances of Ragweed pollen. <i>Journal of the American Chemical Society</i> , 41, 1285–1289.
Asteraceae	<i>Ambrosia</i>	Yellow	
菊科	蒲公英属	黄色	Doroschenko (translated by Zhou AN) (1996) Pollen therapy. <i>Apiculture Of China</i> , 63, 38.(in Chinese) [周安宁 (译) (1996) 花粉治病.中国养蜂, 63, 38.]
Asteraceae	<i>Taraxacum</i>	Yellow	
菊科	矢车菊属	棕色、白色、黄色	Doroschenko (translated by Doroschenko (translated by Zhou AN)) (1996) Pollen therapy. <i>Apiculture Of China</i> , 63, 38.(in Chinese) [周安宁 (译) (1996) 花粉治病.中国养蜂, 63, 38.]
Asteraceae	<i>Cyanus</i>	Brown, white, yellow	
菊科	红花属	白色、黄色	Khidir MO (1970) A note on the inheritance of pollen colour in safflower ( <i>Carthamus L.</i> ). <i>Canadian Journal of Genetics and Cytology</i> , 12, 360–361.
Asteraceae	<i>Carthamus</i>	White, yellow	
菊科	薊属	白色	Zhang SS, Zhang SB (2010) Distinguish the species of nectar plants by pollen color. In: Proceedings of the 11th National Symposium on Pollen Resources Development and Utilization, pp. 113–119. National Pollen Resources Development and Utilization Liaison Group, Pine Pollen Research and Development Center, Chinese Academy of Forestry. (in Chinese) [张石生, 张少斌 (2010) 用花粉颜色来区分蜜粉源植物种类: 第十一届全国花粉资源开发与利用研讨会论文集, pp. 113–119. 全国花粉资源开发与利用联络组、中国林业科学研究院松花粉研究开发中心.]
Asteraceae	<i>Cirsium</i>	White	
桔梗科	风铃草属	紫色、棕色、白色	Koski MH, Berardi AE, Galloway LF (2020) Pollen colour morphs take different paths to fitness. <i>Journal of Evolutionary Biology</i> , 33, 388–400.
Campanulaceae	<i>Campanula</i>	Purple, brown, white	
伞形科	独活属	黄色	Doroschenko (translated by Zhou AN) (1996) Pollen therapy. <i>Apiculture Of China</i> , 63, 38.(in Chinese) [周安宁 (译) (1996) 花粉治病.中国养蜂, 63, 38.]
Apiaceae	<i>Heracleum</i>	Yellow	
五加科	树参属	白色	Zhang SS, Zhang SB (2010) Distinguish the species of nectar plants by pollen color. In: Proceedings of the 11th National Symposium on Pollen Resources Development and Utilization, pp. 113–119. National Pollen Resources Development and Utilization Liaison Group, Pine Pollen Research and Development Center, Chinese Academy of Forestry. (in Chinese) [张石生, 张少斌 (2010) 用花粉颜色来区分蜜粉源植物种类: 第十一届全国花粉资源开发与利用研讨会论文集, pp. 113–119. 全国花粉资源开发与利用联络组、中国林业科学研究院松花粉研究开发中心.]
Araliaceae	<i>Dendropanax</i>	White	
忍冬科	缬草属	棕色	Doroschenko (translated by Zhou AN) (1996) Pollen therapy. <i>Apiculture Of China</i> , 63, 38.(in Chinese) [周安宁 (译) (1996) 花粉治病.中国养蜂, 63, 38.]
Caprifoliaceae	<i>Valeriana</i>	Brown	
唇形科	益母草属	白色	Zhang SS, Zhang SB (2010) Distinguish the species of nectar plants by pollen color. In: Proceedings of the 11th National Symposium on Pollen Resources Development and Utilization, pp. 113–119. National Pollen Resources Development and Utilization Liaison Group, Pine Pollen Research and Development Center, Chinese Academy of Forestry. (in Chinese) [张石生, 张少斌 (2010) 用花粉颜色来区分蜜粉源植物种类: 第十一届全国花粉资源开发与利用研讨会论文集, pp. 113–119. 全国花粉资源开发与利用联络组、中国林业科学研究院松花粉研究开发中心.]
Lamiaceae	<i>Leonurus</i>	White	
木樨科	女贞属	白色	Zhang SS, Zhang SB (2010) Distinguish the species of nectar plants by pollen color. In: Proceedings of the 11th National Symposium

Oleaceae	<i>Ligustrum</i>	White	on Pollen Resources Development and Utilization, pp. 113–119. National Pollen Resources Development and Utilization Liaison Group, Pine Pollen Research and Development Center, Chinese Academy of Forestry. (in Chinese) [张石生, 张少斌 (2010) 用花粉颜色来区分蜜粉源植物种类: 第十一届全国花粉资源开发与利用研讨会论文集, pp. 113–119. 全国花粉资源开发与利用联络组、中国林业科学研究院松花粉研究开发中心.]
紫草科	蓝蓟属	蓝色	Doroschenko (translated by Zhou AN) (1996) Pollen therapy. <i>Apiculture Of China</i> , 63, 38.(in Chinese) [周安宁 (译) (1996) 花粉治病.中国养蜂, 63, 38.]
Boraginaceae	<i>Echium</i>	Blue	
茄科	枸杞属	白色	Zhang SS, Zhang SB (2010) Distinguish the species of nectar plants by pollen color. In: Proceedings of the 11th National Symposium on Pollen Resources Development and Utilization, pp. 113–119. National Pollen Resources Development and Utilization Liaison Group, Pine Pollen Research and Development Center, Chinese Academy of Forestry. (in Chinese) [张石生, 张少斌 (2010) 用花粉颜色来区分蜜粉源植物种类: 第十一届全国花粉资源开发与利用研讨会论文集, pp. 113–119. 全国花粉资源开发与利用联络组、中国林业科学研究院松花粉研究开发中心.]
Solanaceae	<i>Lycium</i>	White	
茄科	矮牵牛属	绿色、黄色、灰色、蓝色、白色	Ferguson MC (1927) A cytological and a genetical study of <i>Petunia</i> -I. <i>Bulletin of the Torrey Botanical Club</i> , 54, 657–664.
Solanaceae	<i>Petunia</i>	Green, yellow, Grey, blue, white	Wiering H, de Vlaming P, Schram AW, Jonsson LMV, Bennink GJH (1984) Inheritance and Biochemistry of Pigments, pp. 49–76. Springer, Berlin, Heidelberg.
报春花科	仙客来属	黄色	Stanley RG, Linskens HF (1974) Pollen pigments. In: <i>Pollen: Biology Biochemistry Management</i> (eds Barendse GAM, Hollis CA, Jorde W, Kirby EG, Kroh M, Lukoschus FS, Nation JL, Peter JK, Robinson FA, Rosen WG, Vasil IK, Murphy JB), pp. 223–246. Springer, Berlin, Heidelberg.
Primulaceae	<i>Cyclamen</i>	Yellow	
山茶科	木荷属	白色	Zhang SS, Zhang SB (2010) Distinguish the species of nectar plants by pollen color. In: Proceedings of the 11th National Symposium on Pollen Resources Development and Utilization, pp. 113–119. National Pollen Resources Development and Utilization Liaison Group, Pine Pollen Research and Development Center, Chinese Academy of Forestry. (in Chinese) [张石生, 张少斌 (2010) 用花粉颜色来区分蜜粉源植物种类: 第十一届全国花粉资源开发与利用研讨会论文集, pp. 113–119. 全国花粉资源开发与利用联络组、中国林业科学研究院松花粉研究开发中心.]
Theaceae	<i>Schima</i>	White	
五列木科	桤属	白色	Zhang SS, Zhang SB (2010) Distinguish the species of nectar plants by pollen color. In: Proceedings of the 11th National Symposium on Pollen Resources Development and Utilization, pp. 113–119. National Pollen Resources Development and Utilization Liaison Group, Pine Pollen Research and Development Center, Chinese Academy of Forestry. (in Chinese) [张石生, 张少斌 (2010) 用花粉颜色来区分蜜粉源植物种类: 第十一届全国花粉资源开发与利用研讨会论文集, pp. 113–119. 全国花粉资源开发与利用联络组、中国林业科学研究院松花粉研究开发中心.]
Pentaphragmaceae	<i>Eurya</i>	White	
凤仙花科	凤仙花属	白色	Zhang SS, Zhang SB (2010) Distinguish the species of nectar plants by pollen color. In: Proceedings of the 11th National Symposium on Pollen Resources Development and Utilization, pp. 113–119. National Pollen Resources Development and Utilization Liaison Group, Pine Pollen Research and Development Center, Chinese Academy of Forestry. (in Chinese) [张石生, 张少斌 (2010) 用花粉颜色来区分蜜粉源植物种类: 第十一届全国花粉资源开发与利用研讨会论文集, pp. 113–119. 全国花粉资源开发与利用联络组、中国林业科学研究院松花粉研究开发中心.]
Balsaminaceae	<i>Impatiens</i>	White	
仙人掌科		红色、棕色	Rose MJ, Barthlott W (1994) Coloured pollen in Cactaceae: A mimetic adaptation to hummingbird-pollination? <i>Botanica Acta</i> , 107, 402–406.
Cactaceae		Red, brown	
蓼科	荞麦属	黄色	Doroschenko (translated by Zhou AN) (1996) Pollen therapy. <i>Apiculture Of China</i> , 63, 38.(in Chinese) [周安宁 (译) (1996) 花粉治病.中国养蜂, 63, 38.]
Polygonaceae	<i>Fagopyrum</i>	Yellow	

豆科 Fabaceae	羊蹄甲属 <i>Bauhinia</i>	黄色 Yellow	Shen YY, Cheng SL, Wang HQ, Ming ZJ (2005) Identification of common intestinal protozoa from pollen grain. <i>Laboratory Medicine and Clinic</i> , 2, 249–250. (in Chinese) [申余勇, 成少利, 王虎清, 明宗娟 (2005) 常见肠道原虫与花粉颗粒鉴别研究. <i>检验医学与临床</i> , 2, 249–250.]
豆科 Fabaceae	豌豆属 <i>Pisum</i>	黄色、橙色、棕色、绿色、白色 Yellow, orange, brown, green, white	Marx GA (1977) <i>Yp-2</i> : A second gene for pollen color in <i>Pisum</i> . <i>Pisum Newsletter</i> , 9, 29–30.
豆科 Fabaceae	驴食豆属 <i>Onobrychis</i>	棕色 Brown	Doroscenko (translated by Zhou AN) (1996) Pollen therapy. <i>Apiculture Of China</i> , 63, 38.(in Chinese) [周安宁 (译) (1996) 花粉治病. <i>中国养蜂</i> , 63, 38.]
豆科 Fabaceae	刺槐属 <i>Robinia</i>	白色、灰色 White, Grey	Doroscenko (translated by Zhou AN) (1996) Pollen therapy. <i>Apiculture Of China</i> , 63, 38.(in Chinese) [周安宁 (译) (1996) 花粉治病. <i>中国养蜂</i> , 63, 38.]
蔷薇科 Rosaceae	蔷薇属 <i>Rosa</i>	棕色、黄色 Brown, yellow	Doroscenko (translated by Zhou AN) (1996) Pollen therapy. <i>Apiculture Of China</i> , 63, 38.(in Chinese) [周安宁 (译) (1996) 花粉治病. <i>中国养蜂</i> , 63, 38.] Shen YY, Cheng SL, Wang HQ, Ming ZJ (2005) Identification of common intestinal protozoa from pollen grain. <i>Laboratory Medicine and Clinic</i> , 2, 249–250. (in Chinese) [申余勇, 成少利, 王虎清, 明宗娟 (2005) 常见肠道原虫与花粉颗粒鉴别研究. <i>检验医学与临床</i> , 2, 249–250.]
蔷薇科 Rosaceae	悬钩子属 <i>Rubus</i>	白色、灰色 White, Grey	Doroscenko (translated by Zhou AN) (1996) Pollen therapy. <i>Apiculture Of China</i> , 63, 38.(in Chinese) [周安宁 (译) (1996) 花粉治病. <i>中国养蜂</i> , 63, 38.]
蔷薇科 Rosaceae	苹果属 <i>Malus</i>	白色、灰色 White, Grey	Doroscenko (translated by Zhou AN) (1996) Pollen therapy. <i>Apiculture Of China</i> , 63, 38.(in Chinese) [周安宁 (译) (1996) 花粉治病. <i>中国养蜂</i> , 63, 38.]
蔷薇科 Rosaceae	梨属 <i>Pyrus</i>	红色 Red	Doroscenko (translated by Zhou AN) (1996) Pollen therapy. <i>Apiculture Of China</i> , 63, 38.(in Chinese) [周安宁 (译) (1996) 花粉治病. <i>中国养蜂</i> , 63, 38.]
蔷薇科 Rosaceae	木瓜海棠属 <i>Chaenomeles</i>	黄色 Yellow	Shen YY, Cheng SL, Wang HQ, Ming ZJ (2005) Identification of common intestinal protozoa from pollen grain. <i>Laboratory Medicine and Clinic</i> , 2, 249–250. (in Chinese) [申余勇, 成少利, 王虎清, 明宗娟 (2005) 常见肠道原虫与花粉颗粒鉴别研究. <i>检验医学与临床</i> , 2, 249–250.]
蔷薇科 Rosaceae	山楂属 <i>Crataegus</i>	绿色 Green	Doroscenko (translated by Zhou AN) (1996) Pollen therapy. <i>Apiculture Of China</i> , 63, 38.(in Chinese) [周安宁 (译) (1996) 花粉治病. <i>中国养蜂</i> , 63, 38.]
蔷薇科 Rosaceae	李属 <i>Prunus</i>	黄色、红色 Yellow, red	Doroscenko (translated by Zhou AN) (1996) Pollen therapy. <i>Apiculture Of China</i> , 63, 38.(in Chinese) [周安宁 (译) (1996) 花粉治病. <i>中国养蜂</i> , 63, 38.]
胡颓子科 Elaeagnaceae	胡颓子属 <i>Elaeagnus</i>	白色 White	Zhang SS, Zhang SB (2010) Distinguish the species of nectar plants by pollen color. In: <i>Proceedings of the 11th National Symposium on Pollen Resources Development and Utilization</i> , pp. 113–119. National Pollen Resources Development and Utilization Liaison Group, Pine Pollen Research and Development Center, Chinese Academy of Forestry. (in Chinese) [张石生, 张少斌 (2010) 用花粉颜色来区分蜜粉源植物种类: 第十一届全国花粉资源开发与利用研讨会论文集, pp. 113–119. 全国花粉资源开发与利用联络组、中国林业科学研究院松花粉研究开发中心.]
葫芦科 Cucurbitaceae	西瓜属 <i>Citrullus</i>	黄色 Yellow	Yang H, Gu Y, Zhang ZY, Luo DX, Sun YD (2017) Effects of different radiation and temperature treatments on pollen viability of watermelon. <i>Jiangsu Agricultural Sciences</i> , 45, 111–113. (in Chinese) [杨红, 顾妍, 张朝阳, 罗德旭, 孙玉东 (2017) 不同辐射及温度处理对西瓜花粉生活力的影响. <i>江苏农业科学</i> , 45, 111–113.]

桦木科	榛属	黄色、白色	Dorosenko (translated by Zhou AN) (1996) Pollen therapy. <i>Apiculture Of China</i> , 63, 38.(in Chinese) [周安宁 (译) (1996) 花粉治病. 中国养蜂, 63, 38.]
Betulaceae	<i>Corylus</i>	Yellow, white	
胡桃科	胡桃属	棕色	Jin XF (1987) The relationship between pollen-color alteration and hydrocarbon generation——A heating experiment by a new approach. <i>Geochimica</i> , 16, 368–375. (in Chinese with English abstract) [金小凤 (1987) 用新的加热试验探讨孢粉颜色与油气生成. 地球化学, 16, 368–375.]
Juglandaceae	<i>Juglans</i>	Brown	
壳斗科	栗属	红色	Dorosenko (translated by Zhou AN) (1996) Pollen therapy. <i>Apiculture Of China</i> , 63, 38.(in Chinese) [周安宁 (译) (1996) 花粉治病. 中国养蜂, 63, 38.]
Fagaceae	<i>Castanea</i>	Red	
杨柳科	杨属	黄色	Zhang SS, Zhang SB (2010) Distinguish the species of nectar plants by pollen color. In: Proceedings of the 11th National Symposium on Pollen Resources Development and Utilization, pp. 113–119. National Pollen Resources Development and Utilization Liaison Group, Pine Pollen Research and Development Center, Chinese Academy of Forestry. (in Chinese) [张石生, 张少斌 (2010) 用花粉颜色来区分蜜粉源植物种类: 第十一届全国花粉资源开发与利用研讨会论文集, pp. 113–119. 全国花粉资源开发与利用联络组、中国林业科学研究院松花粉研究开发中心.]
Salicaceae	<i>Populus</i>	Yellow	
大戟科	油桐属	白色	Zhang SS, Zhang SB (2010) Distinguish the species of nectar plants by pollen color. In: Proceedings of the 11th National Symposium on Pollen Resources Development and Utilization, pp. 113–119. National Pollen Resources Development and Utilization Liaison Group, Pine Pollen Research and Development Center, Chinese Academy of Forestry. (in Chinese) [张石生, 张少斌 (2010) 用花粉颜色来区分蜜粉源植物种类: 第十一届全国花粉资源开发与利用研讨会论文集, pp. 113–119. 全国花粉资源开发与利用联络组、中国林业科学研究院松花粉研究开发中心.]
Euphorbiaceae	<i>Vernicia</i>	White	
亚麻科	亚麻属	绿色、白色、蓝色	Dorosenko (translated by Zhou AN) (1996) Pollen therapy. <i>Apiculture Of China</i> , 63, 38.(in Chinese) [周安宁 (译) (1996) 花粉治病. 中国养蜂, 63, 38.]
Linaceae	<i>Linum</i>	Green, white, blue	
卫矛科	南蛇藤属	白色	Zhang SS, Zhang SB (2010) Distinguish the species of nectar plants by pollen color. In: Proceedings of the 11th National Symposium on Pollen Resources Development and Utilization, pp. 113–119. National Pollen Resources Development and Utilization Liaison Group, Pine Pollen Research and Development Center, Chinese Academy of Forestry. (in Chinese) [张石生, 张少斌 (2010) 用花粉颜色来区分蜜粉源植物种类: 第十一届全国花粉资源开发与利用研讨会论文集, pp. 113–119. 全国花粉资源开发与利用联络组、中国林业科学研究院松花粉研究开发中心.]
Celastraceae	<i>Celastrus</i>	White	
十字花科	芸薹属	黄色	Shen YY, Cheng SL, Wang HQ, Ming ZJ (2005) Identification of common intestinal protozoa from pollen grain. <i>Laboratory Medicine and Clinic</i> , 2, 249–250. (in Chinese) [申余勇, 成少利, 王虎清, 明宗娟 (2005) 常见肠道原虫与花粉颗粒鉴别研究. 检验医学与临床, 2, 249–250.]
Brassicaceae	<i>Brassica</i>	Yellow	
锦葵科	锦葵属	蓝色	Dorosenko (translated by Zhou AN) (1996) Pollen therapy. <i>Apiculture Of China</i> , 63, 38.(in Chinese) [周安宁 (译) (1996) 花粉治病. 中国养蜂, 63, 38.]
Malvaceae	<i>Malva</i>	Blue	
锦葵科	棉属	黄色、白色、橙色	Harland SC (1929) The genetics of cotton. part II. The inheritance of pollen colour in New World cottons. <i>Journal of Genetics</i> , 20, 387–399.
Malvaceae	<i>Gossypium</i>	Yellow, white, orange	Turcotte EL, Feaster CV (1966) A second locus for pollen color in Pima cotton, <i>Gossypium barbadense</i> L. <sup>1</sup> . <i>Crop Science</i> , 6, 117–119.
锦葵科	木槿属	黄色、棕色	Li AQ (1988) Preliminary report on the genetic relationship between different types of satellite chromosomes and several different characters of kenaf. <i>China's Fiber Crops</i> , 10, 6–9. (in Chinese) [李爱青 (1988) 红麻不同类型随体染色体与几个不同性状遗传关系研究初报. 中国麻作, 10, 6–9.]
Malvaceae	<i>Hibiscus</i>	Yellow, brown	

锦葵科	椴属	绿色	Doroschenko (translated by Zhou AN) (1996) Pollen therapy. <i>Apiculture Of China</i> , 63, 38.(in Chinese) [周安宁 (译) (1996) 花粉治病.中国养蜂, 63, 38.]
Malvaceae	<i>Tilia</i>	Green	
无患子科	槭属	绿色	Doroschenko (translated by Zhou AN) (1996) Pollen therapy. <i>Apiculture Of China</i> , 63, 38.(in Chinese) [周安宁 (译) (1996) 花粉治病.中国养蜂, 63, 38.]
Sapindaceae	<i>Acer</i>	Green	
白刺科	白刺属	白色	Zhang SS, Zhang SB (2010) Distinguish the species of nectar plants by pollen color. In: Proceedings of the 11th National Symposium on Pollen Resources Development and Utilization, pp. 113–119. National Pollen Resources Development and Utilization Liaison Group, Pine Pollen Research and Development Center, Chinese Academy of Forestry. (in Chinese) [张石生, 张少斌 (2010) 用花粉颜色来区分蜜粉源植物种类: 第十一届全国花粉资源开发与利用研讨会论文集, pp. 113–119. 全国花粉资源开发与利用联络组、中国林业科学研究院松花粉研究开发中心.]
Nitrariaceae	<i>Nitraria</i>	White	
桃金娘科	桉属	白色	Zhang SS, Zhang SB (2010) Distinguish the species of nectar plants by pollen color. In: Proceedings of the 11th National Symposium on Pollen Resources Development and Utilization, pp. 113–119. National Pollen Resources Development and Utilization Liaison Group, Pine Pollen Research and Development Center, Chinese Academy of Forestry. (in Chinese) [张石生, 张少斌 (2010) 用花粉颜色来区分蜜粉源植物种类: 第十一届全国花粉资源开发与利用研讨会论文集, pp. 113–119. 全国花粉资源开发与利用联络组、中国林业科学研究院松花粉研究开发中心.]
Myrtaceae	<i>Eucalyptus</i>	White	
柳叶菜科	柳叶菜属	蓝色、黄色	Deng TT (2020) A Preliminary Study on the Pollen Color Polymorphism and Pollination Ecology in <i>Chamerion angustifolium</i> . Master dissertation, Central China Normal University, Wuhan. (in Chinese with English abstract) [邓婷婷 (2020) 柳兰花花粉颜色多态性及其传粉生态学的初步研究. 华中师范大学, 武汉.]
Onagraceae	<i>Epilobium</i>	Blue, yellow	
柳叶菜科	挂金钟属	红色	Webby R, Bloor S (2000) Pigments in the blue pollen and bee pollen of <i>Fuchsia excorticata</i> . <i>Zeitschrift für Naturforschung C</i> , 55, 503–505.
Onagraceae	<i>Fuchsia</i>	Red	
千屈菜科	千屈菜属	黄色、绿色	Darwin C (1897) <i>The Different Forms of Flowers on Plants of the Same Species</i> . Cambridge University Press, Cambridge.
Lythraceae	<i>Lythrum</i>	Yellow, green	
牻牛儿苗科	老鹳草属	黄色、紫色	Perez-Udell RA (2022) Geographic Variation in Floral Pigmentation of Us Native Herb, <i>Geranium maculatum</i> , as Evaluated by Traditional and Citizen Science Approaches. PhD dissertation, University of North Georgia, Georgia.
Geraniaceae	<i>Geranium</i>	Yellow, purple	
茶藨子科	茶藨子属	黄色	Doroschenko (translated by Zhou AN) (1996) Pollen therapy. <i>Apiculture Of China</i> , 63, 38.(in Chinese) [周安宁 (译) (1996) 花粉治病.中国养蜂, 63, 38.]
Grossulariaceae	<i>Ribes</i>	Yellow	
芍药科	芍药属	黄色	Shen YY, Cheng SL, Wang HQ, Ming ZJ (2005) Identification of common intestinal protozoa from pollen grain. <i>Laboratory Medicine and Clinic</i> , 2, 249–250. (in Chinese) [申余勇, 成少利, 王虎清, 明宗娟 (2005) 常见肠道原虫与花粉颗粒鉴别研究. 检验医学与临床, 2, 249–250.]
Paeoniaceae	<i>Paeonia</i>	Yellow	Ma Z (2021) Investigation of flower-visiting insects on <i>Paeonia ostii</i> T. Hong et J. X. Zhang and their flower-visiting behavior. <i>Botanical Research</i> , 10, 710–715.
毛茛科	毛茛属	白色、黄色、红色	Chen Y (2009) Measurement of pollen and nectar secretion of different <i>Ranunculu</i> and study on pollination methods. <i>Northern Horticulture</i> , 33, 202–203. (in Chinese) [陈银 (2009) 花毛茛不同品种花粉、花蜜分泌量的测定及传粉方式的研究. 北方园艺, 33, 202–203.]
Ranunculaceae	<i>Ranunculus</i>	White, yellow, red	
毛茛科	银莲花属	蓝色	Webby R, Bloor S (2000) Pigments in the blue pollen and bee pollen of <i>Fuchsia excorticata</i> . <i>Zeitschrift für Naturforschung C</i> , 55, 503–505.
Ranunculaceae	<i>Anemone</i>	Blue	
毛茛科	黑种草属	黄色、紫色	Jorgensen TH, Richardson DS, Andersson S (2006) Comparative analyses of population structure in two subspecies of <i>Nigella degenii</i> :



Ranunculaceae	<i>Nigella</i>	Yellow, purple	Evidence for diversifying selection on pollen-color dimorphisms. <i>Evolution</i> , 60, 518–528.
小檗科	淫羊藿属	黄色、绿色	Wang X, Quan Q, Wang B, Li YX, Huang S (2018a) Discovery of androecium color polymorphism in <i>Epimedium pubescens</i> with habitat preference of anther/pollen color in the genus. <i>Journal of Plant Ecology</i> , 11, 533–541.
Berberidaceae	<i>Epimedium</i>	Yellow, green	
罂粟科	花菱草属	白色、橙色、黄色	Wakelin AM, Lister CE, Conner AJ (2003) Inheritance and biochemistry of pollen pigmentation in California poppy ( <i>Eschscholzia californica</i> Cham.). <i>International Journal of Plant Sciences</i> , 164, 867–875.
Papaveraceae	<i>Eschscholzia</i>	White, orange, yellow	Barrell PJ, Wakelin AM, Gatehouse ML, Lister CE, Conner AJ (2010) Inheritance and epistasis of loci influencing carotenoid content in petal and pollen color variants of California poppy ( <i>Eschscholzia californica</i> Cham.). <i>Journal of Heredity</i> , 101, 750–756.
兰科	蝴蝶兰属	黄色、白色	Li N, Liao XF, Liu XR, Lian FQ (2010) An observation of cross-pollination characteristics of <i>Phalaenopsis</i> cultivars with small and medium size flower and seed germination in vitro. <i>Acta Agriculturae Universitatis Jiangxiensis</i> , 32, 926–967. (in Chinese with English abstract) [李娜, 廖飞雄, 刘晓荣, 连芳青 (2010) 中小花型蝴蝶兰杂交特性和无菌播种培养研究. 江西农业大学学报, 32, 962–967.]
Orchidaceae	<i>Phalaenopsis</i>	Yellow, white	
禾本科	玉蜀黍属	白色、黄色	Ceska O, Styles ED (1984) Flavonoids from <i>Zea mays</i> pollen. <i>Phytochemistry</i> , 23, 1822–1823.
Poaceae	<i>Zea</i>	White, yellow	
姜科	豆蔻属	棕色	Acma FM, Mendez NP (2018) Pollen morphology and pollen elemental composition of selected Philippine native gingers in Tribe Alpinieae (Alpinioideae: Zingiberaceae). <i>Biological Forum</i> , 10, 01–10.
Zingiberaceae	<i>Amomum</i>	Brown	
姜科	茴香砂仁属	绿色	Acma FM, Mendez NP (2018) Pollen morphology and pollen elemental composition of selected Philippine native gingers in Tribe Alpinieae (Alpinioideae: Zingiberaceae). <i>Biological Forum</i> , 10, 01–10.
Zingiberaceae	<i>Etilingera</i>	Green	
姜科	大豆蔻属	棕色	Acma FM, Mendez NP (2018) Pollen morphology and pollen elemental composition of selected Philippine native gingers in Tribe Alpinieae (Alpinioideae: Zingiberaceae). <i>Biological Forum</i> , 10, 01–10.
Zingiberaceae	<i>Hornstedtia</i>	Brown	
百合科	百合属	黄色、橙色、棕色、红色	Guan JZ (2016) Investigation on pollen characters of wild lily. <i>Agricultural Development &amp; Equipments</i> , 22, 75–76+63. (in Chinese) [关婧竹 (2016) 野生百合花粉性状调查研究, 农业开发与装备, 22, 75–76+63.]
Liliaceae	<i>Lilium</i>	Yellow, orange, brown, red	
百合科	猪牙花属	黄色、棕色	Austen EJ, Lin SY, Forrest JRK (2018) On the ecological significance of pollen color: A case study in American trout lily ( <i>Erythronium americanum</i> ). <i>Ecology</i> , 99, 926–937.
Liliaceae	<i>Erythronium</i>	Yellow, brown	
薯蓣科	薯蓣属	白色	Zhang SS, Zhang SB (2010) Distinguish the species of nectar plants by pollen color. In: <i>Proceedings of the 11th National Symposium on Pollen Resources Development and Utilization</i> , pp. 113–119. National Pollen Resources Development and Utilization Liaison Group, Pine Pollen Research and Development Center, Chinese Academy of Forestry. (in Chinese) [张石生, 张少斌 (2010) 用花粉颜色来区分蜜粉源植物种类: 第十一届全国花粉资源开发与利用研讨会论文集, pp. 113–119. 全国花粉资源开发与利用联络组、中国林业科学研究院松花粉研究开发中心.]
Dioscoreaceae	<i>Dioscorea</i>	White	
木兰科	北美含笑属	黄色	Shen YY, Cheng SL, Wang HQ, Ming ZJ (2005) Identification of common intestinal protozoa from pollen grain. <i>Laboratory Medicine and Clinic</i> , 2, 249–250. (in Chinese) [申余勇, 成少利, 王虎清, 明宗娟 (2005) 常见肠道原虫与花粉颗粒鉴别研究. 检验医学与临床, 2, 249–250.]
Magnoliaceae	<i>Michelia</i>	Yellow	
木兰科	木兰属	灰色	Shen YY, Cheng SL, Wang HQ, Ming ZJ (2005) Identification of common intestinal protozoa from pollen grain. <i>Laboratory Medicine and Clinic</i> , 2, 249–250. (in Chinese) [申余勇, 成少利, 王虎清, 明宗娟 (2005) 常见肠道原虫与花粉颗粒鉴别研究. 检验医学与临床, 2, 249–250.]
Magnoliaceae	<i>Magnolia</i>	Grey	
五味子科	五味子属	白色	Zhang SS, Zhang SB (2010) Distinguish the species of nectar plants by pollen color. In: <i>Proceedings of the 11th National Symposium on Pollen Resources Development and Utilization</i> , pp. 113–119. National Pollen Resources Development and Utilization Liaison Group, Pine Pollen Research and Development Center, Chinese Academy of Forestry. (in Chinese) [张石生, 张少斌 (2010) 用花粉
Schisandraceae	<i>Schisandra</i>	White	

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睡莲科 Nymphaeaceae	睡莲属 <i>Nymphaea</i>	黄色 Yellow	颜色来区分蜜粉源植物种类: 第十一届全国花粉资源开发与利用研讨会论文集, pp. 113–119. 全国花粉资源开发与利用联络组、中国林业科学研究院松花粉研究开发中心.] Zhang SS, Zhang SB (2010) Distinguish the species of nectar plants by pollen color. In: Proceedings of the 11th National Symposium on Pollen Resources Development and Utilization, pp. 113–119. National Pollen Resources Development and Utilization Liaison Group, Pine Pollen Research and Development Center, Chinese Academy of Forestry. (in Chinese) [张石生, 张少斌 (2010) 用花粉颜色来区分蜜粉源植物种类: 第十一届全国花粉资源开发与利用研讨会论文集, pp. 113–119. 全国花粉资源开发与利用联络组、中国林业科学研究院松花粉研究开发中心.]
松科 Pinaceae	松属 <i>Pinus</i>	黄色 Yellow	Zhang SS, Zhang SB (2010) Distinguish the species of nectar plants by pollen color. In: Proceedings of the 11th National Symposium on Pollen Resources Development and Utilization, pp. 113–119. National Pollen Resources Development and Utilization Liaison Group, Pine Pollen Research and Development Center, Chinese Academy of Forestry. (in Chinese) [张石生, 张少斌 (2010) 用花粉颜色来区分蜜粉源植物种类: 第十一届全国花粉资源开发与利用研讨会论文集, pp. 113–119. 全国花粉资源开发与利用联络组、中国林业科学研究院松花粉研究开发中心.]
水龙骨科 Polypodiaceae	瓦韦属 <i>Lepisorus</i>	黄色 Yellow	Wang KF, Wu GX, Yan JL (1983) Experimental studies of spore-pollen color changes and their significance in the determination of maturity of organic matter in source rocks. <i>Geochimica</i> , 12, 380–387+431–433. (in Chinese with English abstract) [王开发, 吴国暄, 阎家林 (1983) 孢粉色变模拟试验及其在有机质成熟度研究中的意义. 地球化学, 12, 380–387+431–433.]

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