

Native Species of the Genus *Lilium* and the Closely Related *Nomocharis* in Yunnan, China

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ABSTRACT

The lily is an important ornamental flower that has been cultivated for over 3,000 years, and with the development of breeding technologies, has been widely used in the garden, as potted flower, and for cut flower, floral designing. Lily belongs to the genus *Lilium* of family *Liliaceae*, which comprises over 180 species. China is the major center of *Lilium* distribution in the world; and almost one-third of the species found in China are distributed in Yunnan Province, China. 34 species of the genus *Lilium* are reported: *L. brownii*, *L. rownii* var. *viridulum*, *L. wenshanense*, *L. sulphureum*, *L. sargentiae*, *L. lophophorum*, *L. lophophorum* var. *linearifolium*, *L. nanum*, *L. souliei*, *L. henrici*, *L. henrici* var. *maculatum*, *L. bakerianum* var. *bakerianum* var. *bakerianum* var. *delavayi*, *L. bakerianum* var. *gunnanen*, *L. bakerianum* var. *rubrum*, *L. sempervivoideum*, *L. amoenum*, *L. pinifolium*, *L. nepalense*, *L. nepalense* var. *burmanicum*, *L. habaense*, *L. lankongense*, *L. primulinum*, and *L. lancifolium*; Seven *Nomocharis: N. aperta*, *N. saluenensis*, *N. forrestii*, *N. basilissa*, *N. farreri*, *N. meleagrina*, and *N. pardanthina*. Sampling quantity, environmental survey of wild lily introduction, domestication note and crossing history have been previously investigated. Present and the proposed utilization classification characteristics of 41 native species are discussed in this paper.

Keywords: characteristic, distribution, diacritical point, Lilium and Nomocharis

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INTRODUCTION

China has diverse climates and complex terrain and has a one of the largest distributions and speciation of Lilium species in the world which includes 46 species and 18 varieties, distributed in all regions (Wu 1997). Yunnan Province is located in South-West of China (latitude 21° 8' 32"-29° 15' 8" N., longitude 97° 31' 39"-106° 11' 47" E, altitude 76.4 m (Yuanjiang) to 6,740 m (Deqin)), and has special stereoscopic topography, climate, and product form an interactive biological circle, and has developed special biosphere. The genus Lilium was classified into seven sections which are Martagon, Pseudolirium, Lilium (Liriotypus), Archelirion, Sinomartagon, Leucolirion and Daurolirion by Comber (1947). Lilum of distribution in China was divided into four Sections which are Leucolirion, Lophophorum, Sinomartagon and Martagon by Wang et Tang (1986), later Liang (2000) revised to five section, added Nomocharis. Yunnan Province distribute excluding the section Martagon. In Yunnan Province, about 25 species and 9 varieties of the Lilium, and 7 species Nomocharis are found in the wild habitat (Fig. 1). Eight species of Lilium (L. wenshanense, L. lophophorum var. linearifolium, L. bakerianum var. rubrum, L. amoenum, L. pinifolium, L. lijiangense, L. habaense, L. lankongense), and three species of Nomocharis (N. aperta, N. forrestii, N. basilissa) are both endemic species outside Yunnan (Wu and Xiong 2006).

LILIUM

Lilium brownii

var. brownii

L. brownii var. *brownii* occurs in Lushui, Fugong, Fengqing, Jingdong, Jiangchuan, Kunming, Zhengxiong, Daguan, Pingbian, Maguan, Xichou, Funing, and Yanshan, Yunnan. Plants grow in thickets, and edge of open woodland, at altitude ranges from 700 to 2,500 m above sea level between latitude 23° (Wenshan) to 27° N. (Fugong) (**Table 1**). Its flowers are milk-white, trumpet-shaped, fragrant and exhibits purple hues on the exterior tepals. Its perianth segments turn outward or recurving at the tips, but are not revolute. Papillose are found on each side of the nectary. The bulb is globose, white, without articulate. The scattered leaf shape is considered a diacritical marking with *L. brow*-

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Table 1	The genus	Lilium code,	distribution	altitude,	latitude,	habitat and	l stem	length	I.
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Code	Species	Altitude (m)	Latitude (°N)	Habitat	Stem length (cm)	
Section Le	eucolirion					
1	L. brownii	700-2,500	23-27	Thicket	70-100	
2	L. wenshanense	1,000-2,200	23	Thicket	120-180	
3	L. sulphureum	90-1,900	23-27	Thicket	80-120	
4	L. sargentiae	500-2,000	23-27	Thicket	45-160	
Section Lo	phophorum					
5	L. lophophorum	2,700-4,600	26-28	Mixed Woodland	10-45	
6	L. nanum	3,500-4,800	27	Grassy Slope	10-30	
7	L. souliei	1,200-4,000	26-28	Grassy Slope	10-30	
8	L. henrici	2,800-4,000	26-28	Thicket	60-120	
9	L. bakerianum	1,800-2,800	24-26	Thicket	60-120	
10	L. sempervivoideum	1,400-2,600	24-26	Grassy Slope	20-30	
11	L. amoenum	1,900-2,500	24-26	Grassy Slope	15-30	
12	L. pinifolium	3,300-3,400	27	Mixed Woodland	70-80	
Section Si	nomartagon					
13	L. nepalense	1,500-2,900	23-27	Mixed Woodland	40-120	
14	L. wardii	2,030	25-27	Mixed Woodland	60-100	
15	L. taliense	2,600-3,600	25-27	Mixed Woodland	70-150	
16	L. duchartrei	2,000-3,800	25-27	Mixed Woodland	50-85	
17	L. lijiangense	3,300-3,400	25-26	Mixed Woodland	55-60	
18	L. papilliferum	1,000-2,300	25-26	Mixed Woodland	60-60	
19	L. davidii	850-3,220	25-26	Thicket	50-140	
20	L. fargesii	1,400-3,200	25-26	Grassy Slope	20-70	
21	L. stewartianum	3,600-4,300	26-27	Grassy Slope	20-50	
22	L. habaense	2,800-4,500	26-27	Grassy Slope	45-60	
23	L. lankongense	1,800-3,200	27	Mixed Woodland	40-150	
24	L. primulinum	2,100-3,100	26-27	Mixed Woodland	60-200	
25	L. lancifolium	400-2,500	27	Mixed Woodland	80-150	
Section No	omocharis					
Ι	N. aperta	3,000-3,500	26-28	Grassy Slope	20-50	
II	N. saluenensis	2,800-4,500	27-28	Mixed Woodland	30-90	
III	N. forrestii	3,000-3,850	27-28	Mixed Woodland	30-100	
IV	N. basilissa	3,928-4,255	28	Thicket	35-95	
V	N. farreri	2,800	26	Thicket	35-90	
VI	N. meleagrina	2,800-4,000	27-28	Mixed Woodland	35-100	
VII	N. pardanthina	2,700-4,050	26-28	Grassy Slope	25-65	

Note: **Table 1** Partially resourced from **Wu XW**, **Li SF**, **Xiong L** (2006) Distribution situation and suggestion on protecting wild lilies in Yunnan Province. *Journal of Plant Genetic Resources* **7 (3)**, 327-330 (in Chinese). It was arranged according to a book entitled Yunnan Zhiwu Zhi, China (in Chinese), a habitat-investigating database.

nii var. *viridulum*. Plants will develop one to four flower buds when bulbs grow to 12-14 cm in circumference, flowering from May to June and fruiting from August to October. The karyotype is 2n = 14, 24, 25 = 10m+14st (Liang and Minoru 2000; Wang 1993), and C-banding karyotype is 4C+2CI++6I++6I++2I+T++2I+T++2 (Liu *et al.* 2008).

var. *viridulum*

L. brownii var. *viridulum* is found on grassy mountain slopes, in open woodland, on the sides of mountain valleys, at the edges of fields or near villages, in Fengqing (Nuda to Daxueshan roadside), Yunnan. It grows at an altitude ranges from 1,900 to 2,800 meters above sea level. A major way to identify the two *L. brownii* varieties is by their leaf shape. *L. brownii* var. *brownii* leaves are linearly lanceolated, while *L. brownii* var. *viridulum* leaves are oblanceolate to obovate (**Fig. 2**), and also have larger flowers than var. *browniii*.

This species is still quite common in wide areas, despite extensive harvesting of their edible bulbs. In Wenshan, some plants growing on grassy slopes with taller stem on the side of road, without shade. Fresh flowers contain essential oils, which can be used to make perfume. The bulbs are high starch content, a famous delicacy; bulbs are also used as medicine, which are effective in moistening the lungs and stopping coughing, and that could be used as an antipyretic, sedative, diuretic, etc. The taller stem without shade character might be utilized in lily breeding. In principle, it is adaptable to many soil types, and flourishes in shade or partial shade lighting conditions. The karyotype is 2n=23, 24 (Liang and Minoru 2000).

Lilium wenshanense

Lilium wenshanense is an endemic species, found in Wenshan (latitude is 23° N.), Yunnan. Plants can be grow on grassy mountain slopes, in open woodland, with an altitude ranges from 1,000-2,000 m above sea level. *L. wenshanense* is a surprising easy lily which grows well in full sun as well as in partial shade and under various soil conditions.

They have fragrant, milk-white, open trumpet-shaped flowers with green colored nectaries, without papillose and fimbriate projections. One to seven flowers are produced inflorescence from June to July, when the bulbs grow to 10-14 cm circumference. The bulb is white, and sub-globose, with loose and articulate scales (**Fig. 3**), which is key identifying characteristic to this species. The fruit ripens from August to September. They are not widely growing in the wild area, and the number of population is limited. *L. wenshanense* wild habitat is similar with *L. brownii*, in some places, two varieties could be found together. It can grow 120-180 cm tall without shade, lily breeding also might use this character. The karyotype is 2n=24 (Liang and Minoru 2000). Pollen is ellipsoid, $110.2 \times 42.4 \mu m$, germinal apertures 4 μm (Wu *et al.* 2011).

Lilium sulphureum

L. sulphureum is distributed at a latitude between 23° N. to 27° N., occurs in Jingdong, Eryuan, Dayao (Shiyang town back mountain), Yuliang, and Wenshan, Yunnan. It is found on grassy mountain slopes, on roadside, and in open woodlands, at 1,300-1,900 meters above sea level. The fragrant flowers are white, with yellow hues, found near the papillose-free nectaries of the long perianth segments (17-19 cm).



Fig. 1 The distribution map of the genus *Lilium* and *Nomocharis* in Yunnan, China. Note: Arabic numerals = *Lilium*, Roman numerals = *Nomocharis*. Arranged according to a book entitled Yunnan Zhiwu Zhi, China (in Chinese), a habitat-investigating database. 1 *L. brownii*; 2 *L. wenshanense*; 3 *L. sulphureum*; 4 *L. Sargentiae*; 5 *L. Lophophorum*; 6 *L. Nanum*; 7 *L. Souliei*; 8 *L. Henrici*; 9 *L. Bakerianum*; 10 *L. Sempervivoideum*; 11 *L. Amoenum*; 12 *L. Pinifolium*; 13 *L. Nepalense*; 14 *L. Wardii*; 15 *L. Taliense*; 16 *L. Duchartrei*; 17 *L. Lijiangense*; 18 *L. Papilliferum*; 19 *L. Davidii*; 20 *L. Fargesii*; 21 *L. Stewartianum*; 22 *L. Habaense*; 23 *L. Lankongense*; 24 *L. Primulinum*; 25 *L. Lancifolium*; 1 *N. Aperta*; II *N. Saluenensis*; III *N. Forrestii*; IV *N. Basilissa*; V *N. Farreri*; V1 *N. Meleagrina*; VII *N. pardanthina*.



Fig. 2 Leaf shape of (**A**) *L. brownii* var. *brownii* (lanceolate to linear) and (**B**) *L. brownii* var. *viridulum* (oblanceolate).

Filaments are densely pubescent proximally with nectaries but not papillose on each side. The bulbs are globose, aubergine, with tight scales. *L. sulphureum* sprouts earlier, and has a longer growing period, especially from visible buds to anthesis. Leaves are scattered, and numerous brown bulbils are formed on the axils (**Fig. 4**), which is one of the diacritical points. It can be propagated by seed, bulbils, and bulblets which formed on the scale base, thus leading to a significant distribution numerical. Therefore, all kinds of different yearlings are found at each site. The bulbs can be made delicious foods, while the flowers can be used for ornamental use at home. Therefore, leading to digging of the bulbs from wild area, and planting in pots. The bulbs are used as medicine. *Lilium sulphureum* flowers from June to July, with fruit ripening from August to September. Bulbils propagate character might be utilized in lily breeding (Zheng *et al.* 2009). Comparable with *L. sargentiae*, *L. sulphureum* grows in culture, best in acid, humus rich loam with sand. They are not very hardy, so winter protection should be applied and also susceptible to virus. The karyotype is 2n=24, 36=4m+2sm+14st (Wang 1993; Liang and Minoru 2000), and C-banding karyotype is 2n=24: 2CI + 2I+ 4CI + 2CI + 8I + 2I + T++2IT++2I + N (Hu *et al.* 2009).

Diacritical point: Filaments are densely pubescent proximal; bulbils are brown.



Fig. 3 Bulb of **(A)** *L. brownii* var. *brownii* withour articulations and that of **(B)** *L. wenshanense* with articulation (red oval).



Fig. 4 Brown bulbils of (A) *L. sulphureum* and (B) green bulbils of *L. sargentiae*.

Lilium sargentiae

L. sargentiae is widely spread all over the wild, occurs in Wenshan, Dali, Yuxi, Kunming, and Zhaotong (Daguan xian), Yunnan, at latitude from 23° N. to 27° N. This species grows on grassy mountain slopes, thicket margins, at an altitude ranging from 600-2,100 m above sea level. Flowers are white, with pale green toward base, and yellow green nectarines with glabrous filaments. Stems can grow 160 cm tall, and develop numerous green bulbils on the axil (Fig. 4). The flowering period is from July to August, with the fruit ripening period in October. L. sargentiae is propagated mainly by bulbils and bulblets, thus, the distribute density is still higher in every population. It is one of the easiest lilies to cultivate; however, it does not tolerate lime. Flower bulbs are often used by locals for food, and cultivate in their garden or pots. L. sargentiae is closely related to L. regale, the main difference is that L. sargentiae flowers in a large raceme, but L. regale produces them in an umbel. The karyotype: 2n=2x=24=4m (2SAT) +10st (2SAT) +10t (Liang and Minoru 2000; Wang 1993). Pollen is ellipsoid, 98.2 \times 38.5 µm, with germinal apertures 4 µm (Wu et al. 2011).

Diacritical point: Filaments are glabrous; bulbils are green.

Lilium lophophorum

L. lophophorum is distributed in North-west of Yunnan, latitude from 26° N. to 28° N., and occurs in Gongshan, Deqin (Baimangxueshan), Xianggelila (Xianrendong), Lijiang (Yulongxueshan Mahuangchang), Weixi (Sunluka), Heqing, Ninglang, and Dali. This species grows on grassy mountain slopes, thicket margins, fir forest margins, at 2,700-4,600 m above sea level. Flower perianth is yellow, pale yellow or pale yellowish-green, with extremely sparse purple-red spots or unspotted. Bulb is sub-ovoid, with rather loose, lemon scales. Plant heights will be 10-45 cm. The leaves are clustered to scattered. Flower time is from June to July, with fruit ripening from August to September. L. lophophorum is an odd little lily, with special flower shape, its elongated petals contributed to its aberrant appearance. This species has been placed in Fritillaria as well as in Nomocharis, and some authors thought it should be placed in a separate genus species. This species is sporadically distributed in each wild population. Its special flower shape might be utilized for lily breeding.

Diacritical point: Leaves are narrowly lanceolate, or oblong-lanceolate; found extremely sparse, purple-red spots or unspotted on the tepals.

var. *linearifolium*

This species occurs in Lijiang, Yunnan, in alpine grasslands, at 3,500-4,000 m above sea level, is an endemic species. This species prefer cool conditions with humus rich, acidic soils with half shade, that is comparable to *L. nanum*, and perform best if undisturbed for years.

Diacritical point: This variety differs from the type in having 15-16 linear leaves clustered together in the middle and upper parts of the stem, and conspicuous purple spots are on the yellow flowers.

Lilium nanum

L. nanum was found in Deqin, and Gongshan, Yunnan, latitude about 27° N. This species grows on grassy mountain slopes, cliff, and sequoia forest margins, at 3,500-4,800 m above sea level. The bulb is oblong, 2-3.5 cm tall. The flower is pale purple, purplish red, or yellow, rarely white, outer ones elliptic, usually with deep purple spots adaxially on the solitary nodding campanulate flower. When flower open, some plants are only 10cm tall, some plant height will be 30 cm. Flowering period is in June, and fruiting period is in September. This species currently is rarely found in the wild habitat. The karyotype: 2n=48 (Liang and Minoru 2000).

Diacritical point: Tepals appear pale purple or purplish red, rarely white, with deep purple spots adaxially.

Lilium souliei

L. souliei occurs in Gongshan (Cikai), Bijiang, Fugong, Deqing (Yongyuan), Xianggelila (Leimenkan), Lijiang, Weixi, and Eryuan, Yunnan, distributed from 26° N. to 28° N. This species grows on grassy mountain slopes, *Rhodo-dendron* thicket margins, at 2,800-4,000 m above sea level. Its bulb is narrowly ovoid, white. Plant height is 10-30 cm. Their flowers are purple-red, unspotted. The tepals color is paler inside towards the base of the perianth. From June to July, flower opens, and fruit ripens from August to October. *L. souliei* flower color is really rare in *Lilium*. This species is totally befit to potted flower or garden planting, a wonderful species. Wherever you see it, *L. souliei* looks so lovely, and is sporadically distributed in wild habitat. It is undoubtedly an attractive plant, a valuable material for lily breeding. The karyotype: 2n=24 (Liang and Minoru 2000).

Diacritical point: Tepals are adaxially without spots, and basally non-saccate compare with *Lilium saccatum*.

Lilium henrici

Lilium henrici grows latitude from 26° N. to 28° N. They occur in Gongshan (Gaoligongshan Lumber Mill), Lushui, Weixi, and Lanping, Yunnan, and were generally found on grassy mountain slopes, sometimes in thicket margins, at 2,600-3,400 m above sea level. Bulb is ovoid or sub-globose, white. The plant heights are 60-120 cm. Five to six campanulate flowers develop a beautiful raceme inflorescence. Their flowers are white, with an obvious deep purple-red, and with a blotch inside at the base; the nectarines are green, non papillose. This species needs plenty of moisture during spring, light shade, a moist, cool, humus rich, acidic compost condition. Flowering time is in July. The karyotype: 2n=24 (Liang and Minoru 2000).

Diacritical point: Compare with *L. bakerianum*, *L. henrici* tepals are an obvious, with deep purple-red blotch at base adaxially.

var. maculatum

Diacritical point is the inner tepals with a large, only one purple-red blotch at base adaxially and a few purple-red speckles.

This variety is the closest to the genus *Nomocharis*. The dividing line between the genera is, indeed, a rather artifi-



Fig. 5 *L. bakerianum* var. *yunnanense*, leaves with white pubescence on both surfaces.

cial one. The basal blotches on the perianth segments of this species have not, however, developed into the swellings characteristic of the *Nomocharis* species, so it is possible to separate the genera by this feature. *L. henrici* undoubtedly represents more or less the final stage in the evolution of *Lilium* towards to *Nomocharis*. *L. henrici* var. *maculatum* is the normal form in the west of the range, on the mountains west of the Nu Jiang, and occurs with the type variety on the mountains between the Nu Jiang and Lancang Jiang (Haw 1986). The distribution density is not high in the wild habitat. Its special flower inflorescence is good for lily breeding.

Lilium bakerianum

var. bakerianum

This species occurs in central (Kuming Changchongshan, and Mengzi) and North-west of Yunnan (Dali Cangshan, Lijiang Yulongxueshan Muzhugou, and Xianggelila Sanba), latitude from 24° N. to 26° N. It widely distributed at the edges of woodland, pine forests, forested and grassy slopes, and thicket margins, at 1,500-3,800 m above sea level. The bulbs are broad, 2.5-3 cm tall, with white scale. About 1-5 campanulate nodding flowers will produce when plant height grows 60-120 cm. Flower opens in July, with fruit ripening in September.

Diacritical point: Leaves are glabrous, and tepals are white with spotted.

var. yunnanense

This var. occurs in Lijiang (Ganheba), Yunnan. It grows in pine woods or in meadows at 2,000-2,800 m above sea level. The diacritical point is white pubescent on both surfaces of leaves (**Fig. 5**). This variety differs from the type in unspotted, white or pale rose-pink flowers, white-pilose on both surfaces and papillose on both margins of leaves.

var. rubrum

This var. occurs in Kunming, Lijiang, and Dali, west mountains of Jianchuan, from the north of Dengchuan to south of Mengzi, at 1,500-2,000 m above sea level, is an endemic species. The diacritical point is purple-red to pink tepals.

var. aureum

They occur in Xianggelila, grow in thicket margins, grassy slopes, at 2,000-2,500 m above sea level. The diacritical point is tepals are pale yellow, yellow, brownish yellow or purplish yellow, with purple or purple-red spots adaxially.

var. delavayi

This species is found in Lijiang, and Xianggelila. It grows forested or grassy slopes, at 2,500-3,800 m above sea level. The diacritical point is tepals are yellowish green, pale yellow-green, greenish, or pale green, with purple or bright red spots adaxially.

L. bakerianum is a very complex and different group of different varieties ranging. The stem length is from 20 cm up to more than 150 cm. Flower contains white, green, yellow, pink, and the spots are ample in numerical and shape. Abundent flower colour is excellent material for lily breeding. They are sporadically distributed in wild habitat. Somewhere 2-3 varieties were found together in one population.

Lilium sempervivoideum

L. sempervivoideum rarely occurs in Luquan, and Zhaotong (Xiaowulong), Yunnan, at latitude from 24° N. to 26° N. It grows on grass slopes, at 1,400-2,600 m above sea level. Bulb is sub-globose. Plant height is 20-30 cm. Flower is white nodding campanulate, with minute purple-red basal spots. Flower time is in June. It is unlikely to be very amenable to cultivate, even if it could be obtained (Haw 1986). *L. sempervivoideum* prefers cool conditions with humus rich, and acidic soils with light shade; does best if undisturbed and needs up to 5 or 6 years from seed to flower (Liang and Zhang 1984).

Diacritical point: Tepals are greenish yellow, with deep red spots; and filaments are much longer than anthers.

Lilium amoenum

L. amoenum is widely distributing from 24° N. to 26° N., occurs in Kuming (Aziying), Lijiang, Dali, Luquan, Fumin, Mengzi, Jinping, and Wenshan (Huangcaoba), Yunnan. This species grows on the edges of woodland, grass place, and thicket margins, at 1,900-2,500 m above sea level. This is little-known species, even if bulb grows 6-7 cm circumference would be floriferous. Light fragrant nodding flower is purple-red or purple-rose with red spots. The density is highest in the wild population. Flower opens in June, and fruit ripens in August. The character of smaller bulb florescence might be utilized in lily breeding. It is a rare species which is considered to be on the borderline to the genus Nomocharis, and closely related to L. sempervivoideum. The karyotype: 2n=24=4m+10 St+10t (Wang 1993; Liang and Minoru 2000). Pollen is ellipsoid, $83.7 \times 30.4 \ \mu\text{m}$, germinal apertures 4 µm (Wu et al. 2011). L. amoenum is an endemic species. It is difficult to grow, being cultivated. If they are being blossomed in the first year, they are few to be floriferous in following years.

This species as male crossed to *L. regale* and *L. longiflorum* obtained hybrids has been reported (Huang 1990).

Diacritical point: Tepals are purple-red or rose-purple, with red spots.

Lilium pinifolium

L. pinifolium is an endemic species, occurs in Xianggelila, Yunnan, latitude about 27° N. This species grows in the forest at 3,300-3,400 m above sea level. This species have white sub-glob006Fse bulbs. When they grow 70-80 cm, they will form 2-3 nodding campanulate white flowers that base part tepals are green with red spots. Flowering time is in June. Fruit ripening time is in August.

Diacritical point: Leaves are narrowly linear or subulate, 1-2(-3) mm wide.

Lilium nepalense

L. nepalense has been distributed from 24° N. to 26° N., occurs in Lushui, Cangyuan, Dali, Lijiang, and Lincang, Yunnan. This species grows on the edges of mixed wood-

land, thicket margins, at 1,500-2,900 m above sea level. The bulb is sub-globose, white. The shape of scale is lanceolate or ovate-lanceolate. It is 40-120 cm in height with 1-5 nod-ding, somewhat trumpet-shaped delicate fragrance flower, which are pale yellow or greenish yellow, rarely orange-yellow, with tinged purplish in throat. From June to July, flower opens, and fruit ripens from August to October. The karyotype: 2n=24=2m (2SAT) +2m+2st (2SAT) +6st+10t (Wang 1993; Liang and Minoru 2000). This species have been wildly utilized in lily breeding.

Diacritical point: Leaves oblong-lanceolate, 5-veined.

var. burmanicum

This species is widely distributed from 23° N. to 28° N., was found in Gongshan, Lushui, Longchuan, Ruili, Tengchong, Jingdong, Lincang, Eryuan, Yuanjiang, Lvchun, Kunming, Yaoan, Zhengxiong, Yuliang, Gejiu, Pingbian, Lijiang (Yufengsi), Xichou, and Wenshan, Yunnan. It grows on forests, forest margins, thickets, grassy slopes, hillsides along ravines, at 1,500-2,200 m above sea level.

Diacritical point: Tepals are oblong, $6.5-9 \times 1.3-1.7$ cm.

var. ochraceum

This species occurs in Gengma, Liuku, and Wenshan, Yunnan. It grows in forests margins, grassy slopes or among shrubs, at 2,000-3,000 m above sea level. All varieties of *L. nepalense* distribution density are medium in wild habitat. This species excellent character is that there are multiple purple splashes in throat, which may be utilized in lily breeding.

Diacritical point: Tepals are oblong to oblong-oblanceolate, $3.5-6.5 \times 1-1.3$ cm.

Lilium wardii

L. wardii was easily found in the valleys of the Yalu Zangbu Rivers and their tributaries, and eastward extends to beyond Zayii, almost the border with Yunnan, where occurs in Xianggelila (27° N. to 28° N.). This species grows on grassy slopes or among shrubs, at 2,000-3,400 m above sea level. The wild distribution is still higher. Bulb is sub-globose. The plant height is 50-100 cm, with 2-10 nodding flower. The color of flower is pale purple-red or pink, with deep spotted purple. Flowering period is from July to August, with fruit ripening in August. The advantage of this species is smaller bulb can form many florets on the stem, which might be utilized in lily breeding. This species is easy to grow, being tolerant of soil conditions. It has been found growing among pine trees in the wild, though it is not confined to such situations. It usually has stolon stems, which forms bulblets, and the abundance with which it sets seed, allow it to be readily propagated. The karyotype: 2n=24 (Liang and Minoru 2000).

Diacritical point: Tepals are pale purple-red or pink. Styles are at least 3 times as long as ovary. Leaves are narrowly lanceolate, with 3 impressed veins adaxially.

Lilium taliense

L. taliense natural range of distribution is from latitude 25° N. to 28° N., the mountains between the Lancang Jiang and Jianchuan in north-western Yunnan, towards through Lijiang and Yongning areas, as far east as near Qiaojia in north-east Yunnan, was also found in Gongshan, Xianggelila, Eryuan, Heqing, and Dali. This species grows on the edges of woodland, thicket margins, at 2,600-3,300 m above sea level. Bulb is ovoid, with white tight scales. Leaves are scattered, lanceolate, at the basis with a cluster of white hairs. When they grow 70-150 cm tall, produce 2-5 nodding flower buds. The flowers are white, with purple spots, inner segments are slightly wider than outer segments, with nectaries non-fimbriate projections on each side. Flowering time is from July to August. Fruiting ripening

period is in September. It is higher density distributed in wild habitat. The karyotype is 2n=24 (Liang and Minoru 2000). Pollen is ellipsoid, $127.3 \times 52.4 \mu m$, germinal apertures $4 \mu m$ (Wu *et al.* 2011).

This is a striking species, taller and stranger stem than the rather similar *L. duchartrei*, which also has white flowers. This species excellent character seems to be promising in hybridizing. This species also is a surprisingly easy lily which grows well in full sun as well as in half shade or no shade and under various soil conditions.

Diacritical point: Tepals are white, with purple spots; styles are sub-equaling or slightly longer than ovary.

Lilium duchartrei

L. duchartrei are distributed on the mountains of the Lancang Jiang-Nu Jiang divide in north-west Yunnan, and Lijiang area. The total range of this species extends from 23-28° N. in north-west Yunnan. This species occurs in N. in north-west Yunnan. This species occurs in Gongshan (Bingzhongluo), Fugong, Lanping, Lincang, Deqin (Benzilan), Xianggelila (Sanba), Lijiang, Weixi, Heqing, Dali, and Zhaotong, Yunnan. It grows on pine forest or thicket margins along valleys, grassy slopes, at 2,000-3,800 m above sea level. Bulb is ovoid, white. The plant height is 50-85 cm. They have scattered, lanceolate or oblong-lanceolate leaves. L. duchartrei have 1-12 florets in a umbel. Flowers are nodding, with pleasant scent. Fragrant flower tepals are strongly revolute, white with red-purple spots. Flowering time is in July, and fruiting period is in September. L. duchartrei is moderately lime-tolerant, and prefer a humus-rich, well-drained, loamy soil, and half shade. They need plenty of water during the growing season, but must be reasonably dry in winter. The karyotype is 2n=24 (Liang and Minoru 2000).

This species is similar to *L. lankongense*. The diacritical point is leaf axils with a cluster of white hairs; leaf veins are not elevated abaxially; tepals are white with purple-red spots. It has been commonly propagated by means of the numerous offset bulblets produced on its stoloniferous underground stems, rather than by seed.

Lilium lijiangense

L. lijiangense is an endemic species, occurs in a small area in Lijiang, and Dali, Yunnan, latitude from 25° N. to 26° N. This species grows on the edges of woodland, thicket margins, at 3,300-3,400 m above sea level. The bulb is subglobose, tinged purple white. Their height is 55-110 cm, with a cluster of white hairs scattered, elliptic leaves. They have 1-8 nodding, bright, shiny golden yellow fragrant flowers, with purple or brown spots; nectaries are blackish or red, not papillose. This colouring is both characteristic and very lovely and the small spots define the edges of the shiny petals brilliantly. Each flower is some 6-7 cm in diameter but the petals are curled and are longer when flat, each at some 4.5-5 cm long. Golden to almost orangey anthers set off a perfect bloom and this newly introduced species seems both vigorous and growable. Flowering time is from July to August, fruit time is from September to October. L. lijiangense have many obviously characters, but currently status rarely found in wild habitat. Maybe for these reasons, which are a cheerful colour, local people or tourist cut off the flowers. This species grows well in full sun as well as in half shade under various soil conditions. The karyotype is 2n=24 (Liang and Minoru 2000).

Diacritical point: Leaves are narrowly oblong or ovatelanceolate.

Lilium papilliferum

L. papilliferum occurs in Lijiang (Baimaizi Xueshan), Yunnan. This species grows on mountain slopes among shrubs, bushy slopes, at 1,000-3,000 m above sea level. They have a white ovoid bulb. The plant height will be 60 cm, with scattered, linear leaves, and five nodding flowers. The color



Fig. 6 L. davidii, axil with a cluster of white woolly hairs.

of flower is purple-red; the perianth is segments oblong, acute at the apex, and slightly narrowed at the base; the nectaries are papillae and cristate projections on each side. In July, flower opens, and fruiting period is in September. This species is a rare lily in the wild. The flowers are frequently very dark in color, some plants almost black. It requires well-drained, humus rich loam, and protection in winter. It is unusual lily for breeding, but it is a pity that its distribution is quite few.

Diacritical point: Tepals are purple-red to reddish brown, unspotted.

Lilium davidii

L. davidii is a popular edible lily in Yunnan, latitude from 25° N. to 26° N. Many people cultivate them in their farm to make all kinds of foods (steaming, frying, and salad), using L. davidii bulbs and flowers. They occur in Gongshan, Lincang, Deqin (Cizhong), Xianggelila (Haba), Lijiang (Nudian), Weixi, Jianchuan, Eryuan, Dali, and Kunming, Yunnan. It grows on mountain slopes in meadows, moist places in woodland, or at the edges of woods, at 1,700-3,100 m above sea level. Bulbs are white flattened, globose or broadly ovoid. The plant height will be 50-160 cm, and may produce 2-10 nodding orange, with dark purple spots on the basal two-thirds approximal flowers. Flowering period is from July to August, and fruiting period is in September. The karyotype is 2n=24 =8m+6sm+10st (Wang 1993; Liang and Minoru 2000). Pollen is ellipsoid, 105.3 × 43.4 µm, germinal apertures 4 µm (Wu et al. 2011).

The bulb contains starch of good quality, giving high yields in cultivating. Their bulbs were popularly made foods. It is easily propagated from scaling and also can produce offset bulblets; it is tolerant of a range in soils and drought, and is reasonably resistant to disease. It is also one of the elegant orange. Therefore, there are many reasons for interesting to popularity. Flowers are shiny texture and strong colorful, both characteristics are inherited easily when crossed with other species or hybrids. This species is very easy species, cold-tolerant, comes along with a lot of garden conditions; stems often wander horizontally underground and produce bulbils, large groups can be established rather easy. It is an excellent lily for lily breeding.

Diacritical point: Axils has a cluster of white woolly hairs compare with *L. davidii* var. *willmottiae* (Fig. 6).

Lilium fargesii

L. fargesii occurs in Xianggelila, Zhaotong, and Lijiang, Yunnan, latitude from 25° N. to 26° N. This species grows in pine margins, bushy slopes, at 2,600-3,200 m above sea level. Bulb is ovoid, white. Its height is 20-70 cm tall. The flower is nodding, greenish-white, densely spotted with purple-brown. Nectaries are cristate projections on each side. The flowering time is from July to August, with fruiting period from September to October. It is another lovely

special lily, they have rarely flower color, although, is really harder to find a plant in wild habitat.

Diacritical point is tepals greenish white, with purple or purple-brown spots. This species is similar to *L. callosum*, but differs in having bracts not thickened at the tip, greenish-white flowers with purple spots, and cristate projections on each side of the nectaries. This species is uncommon in the wild habitat and has never been found in cultivation. Flower color might be utilized in lily breeding. The next relative seems to be *L. xanthellum* which has larger bulbs, yellow flowers.

Lilium stewartianum

L. stewartianum occurs in Xianggelila, and Lijiang, Yunnan, latitude from 26° N. to 27° N. It grows on limestone rocks or open rocky grassland, or at the edges of woods, at 3,600-4,300 m above sea level. They have white ovoid bulb. The plant height is 20-50 cm. Flower is nodding, greenish-yellow, with deep red spots, revolute towards the tip, nectaries with fimbriate projections on each side. Flowering period is from July to August. Fruiting period is in October. It seems to be rather uncommon in the wild, and has only, a limited range of distribution, from the mountains of Lijiang area northwards to Xianggelila. It is a very high altitude lily, growing at higher altitude than any other species of this section.

Diacritical point is *L. stewartianum* has greenish yellow tepals, with deep red spots; filaments much longer than anthers. This species is similar to *L. fargesii*, but differs in that the latter forms its flowers in a raceme, and has cristate projections on each side of the nectaries. It is also similar with *L. nepalense* and *L. taliense*. Its perianth segments form a long tube before reflexing; and in color resemble those of *L. nepalense*, it is clearly distinguished by its smooth stem and very narrow leaves.

Lilium habaense

L. habaense is an endemic species, occurs in Xianggelila, Yunnan, latitude from 26° N. to 27° N. This species grows on the open and rocky places, at 3,800-4,500 m above sea level. They have ovoid bulb. The plant height is 40-60 cm tall. The flower tepals are green, with dense, purple spots, nectaries neither papillose nor with fimbriate projections. Flowering time is in June, and fruiting is in August. The karyotype is 2n=24 (Liang and Minoru 2000).

This species also is a higher altitude lily, similar to *L*. *fargesii*, differ in tepals greenish, with purple spots throughout; filaments are slightly shorter than anthers. *L. habaense* is rarely found in wild habitat in currently status.

Lilium lankongense

L. lankongense occurs in Xianggelila, Yunnan, latitude about 27° N, is an endemic species, grows in the alpine grasslands, at 1,800-3,200 m above sea level. Bulb is ovoid, white. The stem will be 40-150 cm tall. They have solitary or several nodding fragrant flowers; tepals are pink, with deep red spots, nectaries are papillose on both surfaces. Flower time is from June to July, with fruit ripening time from August to October. It is rather easy grow in light, moist, acid, and humus rich soil in full sun or half shade; is rather lime-tolerant. The karyotype is 2n=24 (Liang and Minoru 2000).

Diacritical point: Leaf axils are not hairs; leaf veins are elevated abaxially; and tepals are pink, with deep red spots.

Lilium primulinum

L. primulinum occurs in Xianggelila, Yunnan, latitude from 26° N to 27° N. This species grows in the forests, forest margins, thickets, grassy slopes; hillsides along ravines, at 1,100-3,100 m above sea level. This species have sub-globose bulbs. Plant height is 60-200 cm, with 4-9 nodding



Fig. 7 Pollen ultrastructure of 6 *Lilium* species examined with a scanning electron microscope. (A) *L. taliense*, (B) *L. lancifolium*, (C) *L. davidii*, (D) *L. sargentiae*, (E) *L. amoenum*, (F) *L. wenshanense*. From Wu XW, Wang LH, Zhang YP (2011) Eight genus *Lilum* pollen morphology and cluster analysis. *Jiangsu Agricultural Science* 39 (3), 197-199 (in Chinese)

flower; tepals are primrose yellow or greenish yellow, rarely yellowish white, sometimes purple blotches at base; and nectaries are non-papillose.

Diacritical point: Leaves are lanceolate, 3-veined.

Lilium lancifolium

L. lancifolium occurs in Zhaotong, Yunnan, latitude about 27° N. This species grows on mountain slopes among shrubs, in meadows, by the sides of roads or on the banks of rivers, at 400-2,500 m above sea level. It is widely cultivated for edible bulb. Bulb is broadly sub-globose, white. The plant with purple bulbils on the leaf axils will be 80-150 cm, with 3-8 nodding flowers, which are vermilion, with dark purple spots; nectaries are papilla with fimbriate projections on each side. The flowering period is from July to August. Fruiting time is from September to October. The karyotype is 2n=36=6m (3SAT) +12st+15t+3T (Wang 1993; Liang and Minoru 2000). Pollen is ellipsoid, $115.1 \times 45.1 \mu$ m, germinal apertures 4 μ m (Wu *et al.* 2011).

This species bulbils are plentifully produced in the leaf axils of this make propagation easily, which is useful in lily breeding. Lots of local people grow in pot or garden. The bulb has high starch content and can be eaten or used medicinally; the flowers contain essential oil and can be used in making perfume. One of the easiest lilies which can adapt to virtually each garden condition provided a sufficient drainage.

However, this species is easily affected by virus, but without developing symptoms because of their resistance. Therefore, this species should be cultivated separate from other lilies, and garden tools that have been used for cutting should be carefully disinfected.

Diacritical point: Plenty purple bulbils are on the leaf axils.

NOMOCHARIS

Nomocharis aperta

N. aperta occurs in Dali (Cangshan Boluoyan), and Gongshan (Dulongjiang), Yunnan, latitude from 26° N to 28° N, is an endemic species, grows in mixed woodland or meadows on mountain slopes, at 3,000-3,500 m above sea level. Flower is red, pink or pale yellow, with a few to a dozen or more purple-red spots near the base, inner and outer tepals margin entire (=> *N. farreri* only outer ones entire); styles are usually longer than ovary (=> *N. saluensis* styles are usually shorter than ovary). The bulb is ovoid. Plant height will grow 20-50 cm, with 1-2 flowers. Leaves are scattered, broadly to narrowly lanceolate. Flowering period is from June to July. Fruiting time is from September to October. The karyotype is 2n=24 (Liang and Minoru 2000).

This species is very similar to *N. saluenensis*, but differs in having its style longer than the ovary, and in having more heavily spotted perianth segments.

Nomocharis saluenensis

N. saluenensis occurs in Xianggelila (Habaxueshan Nizhuaqing), Deqin, Liuku, and Gongshan (Bingzhongluo), Yunnan. Its wild range is very restricted, from a southern limit of about 27-28° N in north-west of Yunnan. It grows on mountain slopes in forest, at the edges of woods and in meadows, at 2,800-4,500 m above sea level. The bulb is ovoid, 2-4 cm tall, white. The plant height is 30-90 cm. They have 1-7 pink flowers, with tiny purple spots on the inside near the base, conspicuous tiny basal spots, margins. From June to August, flowers open, and from August to September, fruits ripen. The karyotype is 2n=24 (Yu 1994).

Diacritical point: Styles are shorter than ovary.

Nomocharis forrestii

N. forrestii is widely distributed in wild habitat, also is an endemic species. They were collected in Xianggelila (Shuangqiao), Lijiang (Nudian Lidiping), and Gongshan (Dongshaofang), Yunnan, latitude from 27° N to 28° N. It grows on mountain slopes in woodland or in meadows, at 3,000-3,850 m above sea level. They have yellowish-white, ovoid bulbs. The plant height grow 30-100 cm tall, with scattered, lanceolate or ovate-lanceolate leaves; and produce 1-6 pink to red flowers, which are finely spotted on the inside at the base, the spots gradually increased in size towards the upper part and become purple-red blotches, with two purple-red cushion-shaped swellings on the inside at the base. Flowering time is from June to August, with fruit ripening from August to September. The karyotype of A cytotype was 2n=24=2m (2SAT) +2sm+8st (4SAT)+12t (2SAT), and B cytotype was 2n=24=2m (2SAT)+2sm+8st (2SAT)+12t (3SAT) (Yu 1994).

Nomocharis basilissa

N. basilissa is an endemic species, occurs in Gongshan, Yunnan, latitude limit about 28° N. This species grows in alpine regions among thickets of dwarf bamboo or in meadows, at 3,928-4,255 m above sea level. They have 1-5 nodding flowers; petals are red or white tinged with purple at the base. The bulb is small, ovoid, with loose scales. It can reach up to 35-95 cm in stem length. Flowering period is from June to August; and fruiting time is from August to September. The karyotype is 2n=24 (Liang and Minoru 2000).

Nomocharis farreri

N. farreri occurs in Lushui (Pianma), Yunnan, latitude about 26° N. This species grows among other herbs on mountain slopes, at 2,800 m above sea level. The bulb is ovoid or sub-globose, 2.5-3.5 cm tall. Plant height is 35-90 cm. They have 1-5 nodding or horizontal flowers, which are white to pale pink or rose; outer tepals are elliptic margin entire (=> *N. aperta* all tepals are entire elliptic margin), and inner ones densely spotted purple-red or dark brown-red, margins entire or shallowly erose. From May to June flower opens, and from July to August fruit ripens.

Its flowers are in fact very similar in coloration and maculation to those of *N. pardanthina*, which is why these two species were formerly associated together, it is long, narrow leaves bring it closer to *N. meleagrina* and *N. basilissa*. It also resembles them in having comparatively narrow perianth segments.

Nomocharis meleagrina

N. meleagrina occurs in Lijiang (Nudian Lidiping), and Gongshan (Cikai Heipushan), Yunnan, latitude from 27° N to 28° N. This species grows on mountainsides in mixed woodland or at the edges of woods, or in meadows, at 2,800-4,000 m above sea level. They have 2-4 white or pink, nodding flowers, outer perianth with purple-red blotches, margins entire; inner tepals spotted or mainly in distal part blotched purple-red, ovate to elliptic, usually 1.5 times longer than broad (=> *N. pardanthina* inner tepals are usually only slightly longer than broad); the spots of tepals are gradually enlarged into blotches towards the upper part, margins irregularly serrate, apex acute, with deep reddishbrown, fleshy, cristate, cushion-shaped swellings at the base. Flowering time is from June to July, with fruit ripening from August to September.

This species is very close to *N. pardanthina*, but it has perianth segments which are elliptic, longer than broad.

Nomocharis pardanthina

N. pardanthina was found in Dali (Cangshan), and Deqin

(Cangjiang to Yongzi back mountain), Yunnan, latitude from 26° N to 28° N. This species grows on mountainsides at the edges of woods or on grassy slopes, at 2,700-4,050 m above sea level. The bulbs are sub-ovoid, 2.5-3 cm tall. They will grow 25-65 cm tall. This species have 1-5 nodding red or pink flower, with densely purple-red spots; inner tepals densely or laxly spotted or blotched purple-red, are ovate-orbicular, usually only slightly longer than broad (=> *N. meleagrina* inner tepals are usually 1.5 times longer than broad; the spots are gradually increasing in size towards the upper part to become blotches, apex acute, base with purple-red, fleshy, cushion-shaped, cristate swellings (Liang and Zhang 1985). Flowering period is from May to July. Fruiting period is from July to August.

This species is very like *N. meleaoorina*, but differs in sub-orbicular perianth segments which are as broad as long.

Nomocharis species need plenty of moisture, especially during growing season, light shade, a moist, cool, humus rich, acidic compost and high atmospheric humidity. They are not very hardy. Nomocharis generally are not particularly easy to grow, though this is one of the easier species. Many plants that struggle to survive in such a fragile environment in wild habitat. Seed is usually plentifully produced by Nomocharis in cultivation, and is the best method of propagation (Liang 1984). Scaling may also be used as Lilium species, but the bulbs of Nomocharis are rather small, and as they strongly resent root disturbance, lifting established bulbs to remove scales is a risky undertaking (Liang 1995). Seed sown in late autumn or early spring will usually germinate as soon as there is sufficient warmth to permit growth (Yu and Huang 1994). It is best to sow thinly, so that the seedlings may be grown in their pots for a couple of seasons without any disturbance.

THE RELATIONSHIP AMONG *LILIUM* SPECIES IN YUNNAN

Nishikawa *et al.* (1999, 2001) compared nuclear ribosomal DNA of 64 species DNA ITS region including *N. saluenensis*. They showed that *L. nepalense* and *N. saluensis* clade received moderate supporte by 75 bootstrape percentage (BP) in phylogenetic tree. Similarly, Cui and Wu *et al.* (2008) also reported the same result that the clade was formed by *L. nepalense* and *Nomocharis* spp. with a support value of 65 BP in DNA ITS ME tree; the same clade of *L. nanum* and her sister *L. lophophorum* have 68% support in DNA ITS NL tree.

Fig. 1 shows the distribution of wild species in Yunnan, for example, genus *Lilium* (1) *such as L. taliense, L. wardii, L. duchartrei,* and *L. amoenum* are distributed very closely with a latitute range from 25-26° N, and (2) *L. nanum, L. lophophorum, L. henricii* and *L. nepalense* are closely distributed from 26-28° N; beside, genus *Nomocharis,* such as *N. meleagrina, N. forrestii, N. farreri* and *N. pardanthina* are very close too.

THE CURRENT DISTRIBUTION FEATURE GENUS LILIUM IN YUNNAN

Section Lilium, they are distributed in low altitude (less 2,500 m) or low latitude, most of them grow in margin of mixed forest, thicket, roadside. Section Nomocharis are distributed in middle to high altitude (2,800-4,500 m) or high latitude. Section Lophophorum and section Sinomartagon are distributed similarly, from low altitude (400 m) to higher altitude (4,800 m). Many species are situated at the base of shrubs, often in shade and are protected from excessive sunny condition; however, L. brownii, L. wenshansence, L. bakerianum and L. taliense, which inhabit in the wild habitats, may strongly develop not only in shade, but also in full sunny condition. Generally, Lilium grows in a thicket and mixed woodland, which produce taller plants than those of distributing in grassy slope and open habitats. An interesting distribution feature of the wild habitat was found, there is practically a Rhizoma polygonati nearby the



Fig. 8 Pictures of 24 species of the genus Lilium. (A) L. brownii; (B) L. wenshanense; (C) L. sulphureum; (D) L. lophophorum; (E) L. nanum; (F) L. souliei; (G) L. bakerianum var. rubrum; (H) L. bakerianum var. delavayi; (I) L. bakerianum var. delavayi; (J) L. bakerianum var. aureum; (K) L. bakerianum var. bakerianum; (L) L. sempervivoideum; (M) L. amoenum; (N) L. nepalense; (O) L. wardii; (P) L. taliense; (Q) L. duchartrei; (R) L. lijiangense; (S) L. papilliferum; (T) L. davidii; (U) L. fargesii; (V) L. lankongense; (W) L. primulinum; (X) L. lancifolium.

Lilium, thus, maybe the *Rhizoma polygonati* is considered to be an indicator plant to *Lilium*. Currently, wild species (such as *L. davidii and L. sul-* *phureum*) are still widely distributed in Yunnan Province, especially the North-west of Yunnan. The majority of those wild species will not extinct within the short term, if not



Fig. 9 Pictures of six species of the genus *Nomocharis.* (**A**) *N. aperta*; (**B**) *N. saluenensis*; (**C**) *N. forrestii*; (**D**) *N. farreri*; (**E**) *N. meleagrina*; (**F**) *N. pardanthina.*

being subject to serious natural disasters. However, many genera species of *Lilium*, especially individual species, in some distributed areas, their situation are more worrying because of the frequent living activities of the farmers and herdsmen (expanding farm, grazing and tourist), which may exacerbated the decline or extinction of wild *Lilium*.

CUT LILY FLOWER PRODUCTION IN YUNNAN

Yunnan cut lily flower production started from 1990's, Dounan, and Yuxi. The production area were slowly increased until a sharply improvement in 2000. In 2005, Aziying town was rewarded a wonderful name – lily town of China – because of the rapid rising of the cut lily production area. From 2007 to 2011, Yunnan cut lily production are increasing, with area 1133, 1353, 1433, 1593, and 1867 ha, respectively; and the value of lily product are 0.56, 0.54, 0.93, 1.28, and 1.33 billion yuan RMB, respectively (Yunnan Flower Industry Office, China, 2012).

In earlier lily flower production, the main product is Asiatic hybrids, soon be replaced by Oriental hybrids. In currently status, the production pattern of cut lily now is mainly based on Oriental hybrids, supplemented with OT hybrids, Longiflorum hybrids, and Asiatic hybrids. In term of the cut flowers production model, farmers, collaborative organization and professional companies yearly produce cut lily seasonally. In detail, farmers use plastic greenhouse to produce cut lily in summer, while professional companies produce cut lily in winter and spring by plastic greenhouse or glasshouse, which combine with heating system.

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