Indigenous wild tea *Camellias* in China.

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Summary

After many years of field investigations, more than 200 hundred-of-year old indigenous wild tea camellias had been found along 25-degree north latitude in the original center, the southwestern and southern areas of China. More than 10 of them, which exceeded one meter in diameter, had been found in Yunnan province. Meanwhile, some hundred-of-hectare primitive tea camellia populations had been found in Ailaoshan National Nature Reserve, Yunnan province. Most of the primitive tea camellias were primeval species, such as *Camellia tachangensis* F. C. Zhang, *C. crassicolumna* Chang, *C. taliensis* (W. W. Smith) Melchior, etc. There were significant differences in morphological characteristics, chemical components, karyotype, genetic characteristics and progenitive ability between primitive and cultural type tea plants. Important advance had been achieved by using wild tea camellias in the research of tea evolution, morphological classification, interspecific relationship, germplasm innovation and new clone breeding.

Keywords: *Camellia*; China; Distribution; Utilization; Wild tea camellias

1 Introduction

In China, the non-cultivated high and thick tea trees of huge bole and long age, either wild or cultural type, are generally called wild tea camellias. There is still no definite dimension standard and specific age limitation.

There were wild tea camellias since ancient time in China. During Tang Dynasty, Lu Yu (728-804), North Song Dynasty, Song Zian (1604) and Shen Kuo (1093) recorded arbor tea trees in their books. So, there were wild tea trees records 1200 years ago.

The Chinese Crop Germplasm Investigation Team had founded many sites of wild tea camellias in Yunnan, Guizhou, Sichuan, Guangxi, Guangdong, Jiangxi and Hainan provinces since 1980s. The huge number, the wide distribution, the plentiful type of wild tea camellias had caught the world's great attention. They were the important embodiment of biodiversity.

2 The distribution and type of wild tea camellias in China

The wild tea camellias were mainly distributed in four zones and about 200 growing locations.

2.1 Traverse Cordillera distribution zone

It located between N 22-26 degree latitude and E 98-101 degree longitude, i.e. southwestern and western Yunnan province, middle section of Traverse Cordillera, Nujiang River and Lancangjiang River valleys. The discovered hugest and oldest wild tea camellias were growing in this zone, for example, the noted "Bada" (1.0 m in chest-height diameter), "Qianjiazhai" (1.2 m), "Bangwei" (1.14 m) wild tea camellia, etc. The rest wild tea camellias exceeded 1.0 m in diameter were almost in this zone. Their common characteristics were high arbor; large and leather texture leaf; young shoot, apical bud and leaf without pubescence; large flower, 10-13 petals, (4) 5-locule ovary, (4) 5-splitting style; 2-3 mm thickness pericarp. They were *Camellia taliensis*, occasionally *C. gymnogyna* with 3-locule ovary.

2.2 Yunan, Guangxi and Guizhou distribution zone

It located between N 23-26 degree latitude and E 102-107 degree longitude, the common boundaries of Yunan, Guangxi and Guizhou province. It was the original center of tea plant (Yu, 1986; Yu & Xu, 1999). There were some famous wild tea camellias, such as "Shizong" (0.52 m) in Yunnan, "Baping" (0.62 m) in Guangxi, "Xingyi" (0.34 m) wild tea camellia in Guizhou province. The followings were their common characteristics, high arbor; leather texture leaf; large flower 5-8cm in size, 9-15 petals, ovary without pubescence, (4) 5 (7)-splitting style; capsule in flat or circular round shape with 3-4 mm middle thick pericarp. The typical species was *C. tachangensis*, a small ratio was *C. crassicolumna*, ovary with pubescence, capsule with 5-10 mm thick pericarp.

2.3 Yunnan, Sichuan and Guizhou distribution zone

It located between N 27-29 degree latitude and E 104-107 degree longitude, the conjecture area of Yunnan, Sichuan and Guizhou province, a transitive area from Yungui Plateau to the second Mesa. The wild tea camellias were arbor or semi-arbor trees, such as "Zhengxiong" (0.42 m) in Yunnan, "Gulan" (0.48 m) in

Sichuan, "Xishui" (0.50 m) wild tea camellias in Guizhou province. Their common characteristics were high arbor, 7-10 petals, 3-locule ovary without pubescence, 3-splitting style. They were *C. gymnogyn*, occasionally *C. sinensis* var. *assamica*.

2.4 Lingnan Cordillera distribution zone

It was a narrow long zone along N 22-26 degree latitude including the two sides of Lingnan Cordillera. The northern part was famous for semi-arbor and large leaf 'kucha", for example "Jianghua kucha" and "Lingxian kucha" in Hunan, "Longshan kucha" and "Ruyuan kucha" in Guangdong, "Anyuan kucha" and "Xunwu kucha" in Jiangxi province, etc. "Kucha" usually had high content of tea polyphenol and a special strong bitterness component, [6-0(β -D-Xyropyranosyl)- β -D-glucopyranosyl eugenol]. It was supposed to be an interspecific hybrid of *C. sinensis*×*C. oleifera*.

The southern part, along the Hongshuihe River basin in Guangxi and Mt. Dayaoshan in the northern Guangdong province was famous for rich pubescence wild tea camellias. They were semi-arbor, large leaf; young shoot, apical bud, petal, sepal and ovary with plentiful pubescence, 3-spilitting style. They belonged to *C. sinensis* var. *pubilimba*. "Conghua Yecha" and "Liannan Dayecha" in Guangdong, "Zhongshan Leidiancha" and "Kaishan Baimaocha" in Guangxi province were representational wild tea camellias. Additional, there were wild tea camellias of 10 m height, 0.29 m in diameter in Mt. Shiwan Dashan, and pear-shaped sport, semi-arbor wild tea camellias in Mt. Liuwan Dashan in Guangxi.

Except for the four continuous zones, there was non-continuous distribution in Nandieling and Maolashu in Hainan Inland. The wild tea camellias were semi-arbor, large yellow-green leaf, young shoot without pubescence and of high resistance. They belonged to *C. sinensis* var. *assamica*. The trees grew in virgin forests, so they could not be desolated from early-cultured tea garden. The scientist in Taiwan found a wild tea camellia in the virgin forest in Nantou county. It was 14.8 m height, 0.37 m in diameter and about 92 years old (Wu *et al.*, 1994). It was *C. gymnogyna* according to its morphological characteristics.

3 The value of wild tea camellias

3.1 Research for the original center of tea plant

The original center of tea plant was a controversial problem. The scientists had disputed for hundreds of years. According to the genetic diversity and the dense distribution of the wild tea camellias, we proposed that Yunnan province is the original center of the tea plant (Yu, 1986).

Firstly, almost all of the species and varieties in section *Thea* distributed in Yunnan province. According to Chang's taxonomic system, there were 37 species and 3 varieties in the section, 32 of them distributed in Yunnan province (Chang, 1984), corresponding to 82.5%. The most primitive species, such as *C. tachangensis*, *C. crassicolumna* centralized in the southeastern and southern Yunnan province. Only the original center of the plant had the high diversity. Secondly, almost all of the oldest, highest and thickest wild tea camellias concentrated in Yunnan province. It was the typical characteristics of the original center of tea plant. Thirdly, the taxonomists suggested that the Theales and Magnoliales be sister groups, that was to say they had some close relationship. The discovery of *Magnolia miocenica* fossil in Jinggu, Lingcang, Lancang, Jingdong Lianghe and Tengchong in southwestern Yunnan province, where were the densest distribution zone of wild tea camellias nowadays, could support the view of original center of tea plant (He, 1995).

3.2 Research for evolution and classification of tea plant

3.2.1 Evolution

It took a very long procedure for tea plants to evolve from the primitive population to a few species, subspecies and varieties. We systematically evaluated over 600 accessions using multidiscipline methods and found the morphological characteristics and genetic basis had took place continuous and gradual variation (Table 1)(Yu & Xu, 1999)

3.2.2 Classification

Tea plant was self-incompatibility and allogamy. Great number of variation and ecotype made the classification of species very difficult. There were more than 10 classification systems in the recent 200 years. We systematically investigated and studied the tea germplasms preserved in China National Germplasm Menghai Tea Repository Branch and China National Germplasm Hangzhou Tea Repository, especially as well as more than 200 wild tea camellias. We found tea plants do exit different evolutionary stage, characteristics, cross compatibility and utilization value species and varieties. However, it was not tens of species. A new phylogenetic classification system of tea plants was put forward on the basis of the previous scientists' work and our research results. It was mainly based on the locule number of ovary, the splitting number of style and the pubescence of ovary. Meanwhile, the thickness of pericarp, sepal exterior pubescence, the size of flower and the other morphological characteristics, such as tree habit, branch and

leaf characteristics were considered. The tea plants were revised into 5 species and 2 varieties: *Camellia tachangensis*, *C. crassicolumna*, *C. taliensis*, *C. gymnogyna*, *C. sinensis*, *C. sinensis* var. *assamica* and *C. sinensis* var. *pubilimba* (Chen *et al.*, 2000).

Table 1 Main characteristics comparison between wild and cultivated tea plants

Items	Wild tea plant	Cultivated tea plant
Tree shape	Arbor and semi-arbor, mostly erect	Semi-arbor and shrub, mostly semi-spreading and spreading
Leaf	Middle or large, 10-25 cm in size; surface cuticle thicker, crisp; vein unclear; surface smooth or slightly elevated; spare and obtuse serrulate margin	Middle or small, 6-15 cm in size; soft and thick texture; vein clear; surface smooth or slightly elevated; acute serrulate margin
Shoot	3-5 scales on overwintering bud; green or yellow green, without or with slight pubescence	2-3 scales on overwintering bud; yellow green or greenish, with or slight pubescence
Corolla	4-8 cm in diameter, 8-15 petals, white and thick	2-4 cm in diameter, 5-8 petals, white, greenish or reddish
Androecium	70-250 filaments, thick and long; large anther with odors	110-300 filaments, thin and long; small anther with fragrance
Gynoecium	Ovary with or without pubescence, (3) 4-5-splitting style	Ovary with or without pubescence, 2-5, mostly 3-splitting style
Capsules	Diameter 3-5 cm, 0.2-1.2 cm hard pericarp, thick and long central axis	Diameter 2-4 cm, 0.1-0.2 cm soft pericarp, short and thin central axis
Seed	2 cm in diameter, scabrous, brown or deep brown, globose, reniform or subglobose, seed ridge angular	1-2 cm in diameter, smooth, brown or deep brown, mostly globose, seed ridge unclear
Chemical components	Lower contents of amino acids, tea polyphenol and EGCG, higher content of phenylalanine	Higher contents of amino acids, tea polyphenol and EGCG, lower content of phenylalanine
Esterase isozyme	Fewer bands, processing 4 basic bands, EST2, EST3, EST6 and EST8	More bands, usually processing 9 bands, EST2, EST3, EST6, EST8, EST9, EST10, EST12, EST14, EST17
Terpine index	Mostly>0.7	Mostly<0.7
Pollen	Large grain, near globose or flat globose shape, mostly thin reticulate exine ornametation, fine and long aperture, P/E>0.8, Ca content >10%	Small grain, near globose or globose shape, mostly thick reticulate exine ornametation, groove aperture, P/E<0.8, Ca content <5%
Leaf structure	Thick cuticle, upper surface cell larger, palisade tissue 1 layer, stomata density lower, sclereide big with starry branches	Thin cuticle, upper surface cell small and closely arranged, palisade tissue 2-3 layers, stomata small, sclereide rare and small usually reniform
Karyotype	Mostly 2A type, higher symmetry	Mostly 2B type, lower symmetry

3.3 Germplasm innovation and utilization tea plant

In the massive wild tea camellias, there were many elite and special germplasms, some of them were directly used of cultivars, some of them were used for innovation, the other of them were used for functional components extract, etc.

3.3.1 Directly cultivated by local residents.

More than 50 wild tea camellias were planted by local residents in the early period. Six of them were registered as national cultivars in 1985.

3.3.2 For tea breeding use

In the recently 30 years, 30 new clones were selected from the half-sib of the Yunan Daye Cha, 23 and 7 of them have been registered as national and provincial clones, respectively.

3.3.3 Many specific germplasms were discovered.

1) High polyphenol germplasms: The content of polyphenol of some wild arbor wild tea camellias in the Mt. Gaoligong in the southwestern of Yunnan were higher than 41%, the purity of products reached 98%. There were also some germplasms exceeded 38% in Guangxi province. 2) High amino acids germplasms: The amino acids of a wild tea camellia in the Mt. Ailaoshan were 6.5%. It was the highest one discovered now. The other was a natural mutation in Zhejiang province, 6.3%.3) Special tea germplasm: There was a kind of wild tea plant in Mt. Dayaoshan in Guangxi, with which might bit copper cash into powders. There was a similar kind of wild tea plant in Yunnan, too.

Literature cited

Chang HT. 1984, A revision of the tea resource plants. *Acta Sientiarum Naturalium Universitatis Sunyatseni*, (1): 1-12

Chen L, Yu FL, Tong QQ. 2000, Discussions on phylogenetic classification and evolution of sect. *Thea. J. Tea Sci.*, 20(2): 89-94

Chen XY. 1994, Yunnan—Origin of tea plant. Yunnan People's Press, Kunming pp7-10

He CX. 1995, The original place and center: discussion from fossils of Magnolia. *Journal of Yunnan Tea*, (2): 1-9

Li B, Chen XY, Chen GB, Wang JG. 1986, The analysis of karyotype in tea plant. *J. Tea Sci.*, 6(2): 7-14

Takeo T, You XQ, Wang HF, Kinukasa H, Li MJ, Cheng QK, Wang HS. 1992, One speculation on the origin and dispersion of tea plant in China——One speculation based on the chemotaxonomy by using the contest-ration of terpen—alcohols found in the aroma composition. *J. Tea Sci.*, 12(2): 81-86

Wu ZD, Feng JH, Cai JM. 1994, Observation of wild tea tree morphology in Taiwan Meiyuanshan (Chinese Teaman Friendship Association, eds.). Indigenous tea trees in China. Shanghai Culture Press, pp72-84

Yu FL, Xu N. 1999, Tea germplasm resources of China, In: Global advances in tea science (Tain NK,eds) pp 393-406

Yu FL. 1986, Discussion on the originating place and the originating center of tea plant. *J. Tea Sci.*, 6(1): 1-8