

# **Study on Variation of Growth Characteristics and Quality of Yung-Kang Wild Tea in Taitung**

Hun-Yuan Cheng    Horng-Jey Fan    Chin-An Yu

## **Summary**

This experimental research was used Taitung Yung-Kang wild tea collected from Taitung Branch, Tea Research and Extension Station as the experimental material to carry out investigation and analysis of plant growth, yield, agronomic characteristics and tea quality of the tea tree, and to understand the production characteristics of Yung-Kang wild tea tree as breeding selection, development and utilization. The experimental results show that the Yung-Kang wild tea was a semi-arbor type with a tree height of approximately 80 to 90 cm and a maximum tree width of 150 to 170 cm. The growth vigor was strong and the tea tree has a wide canopy. The maximum leaf area was 15.5 to 37.6 cm<sup>2</sup> in different annual tea seasons. The leaf area of different plants was more variable than other leaf characteristics. The leaf shape was mostly lanceolate and elliptical. The highest shoot density of individual plants was ranged from 47 to 160 buds / 30 × 30 cm, with the growth characteristics of bud number, and there were suitable 100 buds weight with average bud weight of 75 to 164 g. The highest yield per plant was 290 to 663 g / plant, which was higher than that of large-leaf cultivars. The yield per plant varies greatly, from which high-yield individual plants can be screened. Whether it is made of green tea or black tea, Yung-Kang wild tea has good quality and special flavor, showing a wide range of characteristics.

**Key words:** Yung-Kang wild tea, Growth, Quality

# **Study on the Leaf, Flower and Fruit Morphology of Shian Yuan, Gao Lu and Variant Tea Trees**

Hun-Yuan Cheng

## **Summary**

The shoot morphology of Shian Yuan, Gao Lu and variant tea trees was different from other cultivars, belong to rare local special cultivars (lines). It can be used in the production of special teas, but its growth characteristics of tea trees have yet to be understood. Therefore, this experiment intends to establish leaf, flower and fruit morphology data, which will be used as reference for tea tree growth, breeding materials, cultivation management, and the development of new flavor teas. The results show that leaf type of Shian Yuan and Gao Lu were broad ellipsoid, leaf apex blunt or slightly concave, leaf base blunt shape, leaf surface wrinkled, leaf margin undulation, large serration, which was large leaf cultivar. The variant tea tree leaf type was lanceolate, the leaf margin was uneven, the surrounding of the leaf margin was yellowed and yellowish, and the leaves were yellow, green and white inlaid with variegated leaves, belonging to small leaf cultivar. The leaf area size of the Shian Yuan was different on the same naturally growing plant. The leaf type includes oblong, oval, broad ellipsoid and ellipsoid. Six

types can be distinguished according to leaf size, which were extra large leaf, large leaf, large round leaf, medium and small leaf near round, medium and small leaf, extra small leaf. All three special tea tree shoot have the same pubescence condition. The dormant buds were all covered with hair, and the young branches, the lower surface of the leaf, the middle rib of the lower surface of the leaf and the petiole were pubescence. The petal number of Shian Yuan was 8.3, the filament number was 326.2 and style length was 0.84 cm, which was larger than that of Gao Lu 7,242, and 0.38 cm. The majority of other floral characteristics were smaller than that of Gao Lu, and the filament number of tea variant was the least, only 140.4. The style length was the shortest, 0.08 cm, the arm length was 0.94 cm and the style diameter was the thinnest, 0.23 mm. Although the large amount of flowering, no fruit was seen. All three special tea trees have ovary pubescence condition. Sepal of Shian Yuan and Gao Lu was only inner pubescence. The pistil was co-located with respect to the stamen height. The Shian Yuan has high split position, and the variant tea tree has very low split position. Shian Yuan can collect capsules containing one to three seeds. The shape of the fruit was spherical, kidney and triangle. Seed shape was spherical, hemispherical and irregular. Gao Lu can collect capsules containing one or two seeds. The fruit shape was spherical and kidney-shaped and the seed shape was spherical.

**Key words:** Shian Yuan, Gao Lu, Variant, Morphology

## **Study on the Leaf, Flower and Fruit Morphology of Taiwan Native Wild Tea Trees**

Hun-Yuan Cheng

### **Summary**

Taiwan native wild tea tree was unique germplasm resource. Its application to tea tree breeding and the development of new products were increasingly valued. Only the growth characteristics of its tea trees need to be understood. Therefore, this experiment intends to establish leaf, flower and fruit morphological data. This was used as reference basis for the maintenance biodiversity, ecological conservation, germplasm preservation and restoration, breeding materials, ingredient development and utilization. Experiment results show, Taiwan's native wild cultivated tea leaves were mostly lanceolate. The leaf shape of the large-leaf and small-leaf cultivars was diverse, most of them were elliptical and oblong and the leaf tip shape of some small-leaf cultivars was slightly concave, which was not found in native wild tea tree and large-leaf cultivars. The dormant buds of De Hua She wild tea, Yung Kang wild tea, large-leaf and small-leaf cultivars were pubescence, while other native wild tea trees have no pubescence. The young branches, under leaf surface, middle leaf rib on leaf surface, petiole pubescence of De Hua She wild tea, Yung Kang wild tea and small-leaf cultivar, most large-leaf cultivar were pubescence, other native wild tea trees were smooth. The young and mature leaf characteristics of different native wild cultivars were significant difference, and their leaf characteristics were also significantly different from those of large and small-leaf cultivars. Yung Kang wild tea has higher degree of interpose and expose than other native wild tea trees. De Hua She wild tea has ovary pubescence. Other native wild tea trees were smooth. Native wild cultivars have more pistils than their stamens in height. The large-leaf or small-leaf cultivars were mostly high. De Hua She wild tea filaments was significantly larger than other wild tea trees, Le Ye wild tea and Yung Kang wild tea were the least, native wild cultivated filaments were the least, and small-leaf cultivars were the most. De Hua She wild tea and Min Chai wild tea have the longest stylus + arm length, Yung Kang wild tea has the shortest, and the native wild cultivars were significantly smaller than the small-leaf cultivars.

The fresh weight, dry weight and size of the fruit and seeds of Yung Kang wild tea were lighter and smaller than that other native wild tea tree and cultivars, especially the dry weight of seed kernel. The mature leaf characteristics of Yung Kang wild tea in the mature stage gradually grew to the native growth pattern with the age of the tree. Most of the young and mature leaf characteristics were significantly greater at altitude of 175 m than that 850 m. Only the internode diameter and leaf thickness showed opposite results. The eastern Yung Kang wild tea and the western (central and southern) native wild tea tree showed different leaf morphological characteristics and mature leaf traits.

**Key words:** Taiwan native wild tea tree, De Hua She wild tea, Yung Kang wild tea, Morphology

## **Effects of Shading on the Growth of Yung-Kang Wild Tea, Dah-Yeh Oolong, Chin-Shin Oolong, TTES No. 12 Cultivars and Quality of Green Tea, Pouchong Tea, Honey-Flavor Green Tea in Spring and Winter Tea Seasons**

Hun-Yuan Cheng

### **Summary**

The purpose of this experiment was to investigate the growth of different tea cultivars in the shade environment of the spring and winter tea seasons, and the effect on the quality of manufacture tea, so as to understand the shade adaptability of different tea cultivars and serve as reference for the application of shade facilities in tea gardens. The experimental treatments included (A) shading facilities (70%), (B) shading facilities (50%), and (C) control plot (no shading, CK). According to the experimental results, it has the effect of cooling and moisturizing in the shaded plot of the spring tea season, which can reduce the luminosity by 60-70%. The temperature in the shaded plot of the low temperature period of the winter tea season rises instead, which was most obvious at night, which was beneficial to achieve the effect of heat preservation and relative humidity was also reduce. The shading of the spring and winter tea seasons has little effect on the shoot growth of Yung-Kang wild tea and TTES No. 12. The growth of Dah-Yeh Oolong was effect when shaded at 70%. The growth of Chin-Shin Oolong was better by 50% shading. The leaf growth of four cultivars in shaded environment of winter tea season was better than that in spring tea season. The shoot density in the shaded plot of the spring and winter tea season was lower than that in the non-shade plot. Among different cultivars, Yung-Kang wild tea has the least influence. Followed by TTES No. 12 and Chin-Shin Oolong, Dah-Yeh Oolong was vulnerable. The 100 buds weight of Yong-Kang wild tea and TTES No. 12 was not affected by shade. Dah-Yeh Oolong has great influence. Chin-Shin Oolong has higher 100 buds weight by 50% shading. The shoot yield difference between shade and non-shade treatment was not significant in Yung-Kang wild tea. Other cultivars have significantly affected yield in 70% shading. Its influence was in order: Yung-Kang wild tea, TTES No. 12, Chin-Shin Oolong, Dah-Yeh Oolong. The green tea and pouchong tea quality was not affected by shading in TTES No. 12, Yung-Kang wild tea and Chin-Shin Oolong. Dah-Yeh Oolong has significant effect. The honey-flavor green tea quality of Yung-Kang wild tea and Chin-Shi Oolong in the shaded plot was better than that in the non-shaded plot. TTES No. 12 and Dah-Yeh Oolong were not affected. The shade of the spring tea season can improve the quality of

honey-flavor green tea compared to the winter tea season. According to the response of shoot growth, yield and quality of tea tree in shade environment, it can be seen that Yung-Kang wild tea was more shade-resistant.

**Key words:** Tea tree, Shading, Growth, Quality

## **Nutrition Analysis and Diagnosis on Soil and Tea Trees in Eastern Taiwan Tea Gardens**

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### **Summary**

The purposes of this study were to investigate the soil physicochemical properties of tea trees plantation in eastern Taiwan and to analyze the relationship between the soil and the nutrition contents of plants. Based on the references of the tea farmlands' potential productivity, soil properties, the recommended reasonable fertilizing quantity and method could reduce fertilizer costs and maintain ecological environment. The nutrition content survey of tea trees in eastern Taiwan revealed that the soil fertility status in tea estate of the Central Mountain Range district is moderate. However, the soil at the East Rift Valley district is slightly acidic. Its soil available P content is slightly high, while the organic matter, the exchangeable K and Mg content is low. As to the tea estate of the Seashore Mountain Range district, its subsoil available P content is slightly low but exchangeable Ca and Mg are high. Total N, P, and K contents in young leaves of tea trees are much higher than the old ones. However, the contents of total Ca and Mn are contrary to the former results. The contents of total Zn and Cu are inconsistent. Mostly, the contents of the main elements of leaves-N, P, K, Ca, and Mg are adequate and so are the microelements of leaves-Fe, Mn, Cu, and Zn. Different tea tree districts have similar results.

**Key words:** Tea Garden in Eastern Taiwan, Tea tree, Soil, Nutrient

## **Study of Control Technology and Integrated Control Strategy for Tea Mosquito Bug, *Helopeltis fasciaticollis* (Heteroptera: Miridae)**

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Hsin-Kuang Tseng    Jeng-Sheang Jiang

### **Summary**

Tea mosquito bug (TMB, *Helopeltis fasciaticollis*) is an important harming insect of tea production countries in tropical and subtropical areas. It generally caused 25 to 50% yield loss and might be

causing no harvest at all without appropriate management. However, there is only one authorized pesticide for this pest control in Taiwan so far. Furthermore, except the authorized pesticide there hasn't any other controls been accommodated in Taiwan. Therefore, a series of experiments aimed at developing various controls such as chemical, physical, cultural, and biological controls had been conducted in this study. It also examined the control effect of combination of several controls. A host range investigation showed TMB mainly feeds broad-leave plants. In chemical control, six testing pesticides showed effective control to TMB. Wood's lamp (range 354-374 nm) and LED (range 370-390 nm) could trap TMB thus reduced the hazard rate of tea sprouts. To use blow-in type trap frequently has a tendency to reduce the population of TMB. Based on the TMB mainly lay eggs on the stems and petioles, regular harvesting and pruning could remove the insect source and reduce the pest population in the field. The correlation between different weed heights and tea sprouts damaged by TMB was not significant, but it might more closely related to climatic environmental factors and tea sprouts growth. In the test of repellent plants to TMB, the results showed that the mint and lycopene had their repellent effect on the TMB. In microbial control, *Beauveria bassiana* Bb011 isolated in this study can effectively control TMB in laboratory tests, and can produce a large number of spores, indicating the potential application to the field. In the integrated control test, the results showed that there was a significant difference between the treatments with the chemical agent or the bio-pesticide combined with the insect trap and the control group. Among treatments, the treatment effect of pesticides combined with insect traps was the most effective, not only TMB population was low, the rate of harmed tea sprouts was low, and the tea yield was higher than control. In the test of tea processing by the harmed tea leaves, the results showed that it was suitable to make the heavily fermented Oolong tea and the fully fermented black tea. Overall, it suggested to coordinate the pest ecology, tea plantation climate and environmental conditions, and farming habits to select the appropriate prevention and control strategy was the best method to achieve effective prevention and control.

**Key words:** Integrated pest management (IPM), Piercing pest, Pest occurrence ecology

## **Effects of Different Packaged Methods on the Quality and Volatile Compounds of Small Leaf Black Tea during Storage**

Hsuan-Han Huang   Chih-Chun Kuo   Chiao-Sung Chiou   Meei-Ju Yang

### **Summary**

In this experiment, the small-leaf black tea (*Camellia sinensis* var. *sinensis*) were packaged in three different ways, including heat-sealed package combined with deoxidizer, heat-sealed package and clip-sealed package. The purpose of this study was to investigate tea quality and volatile compounds changes during storage. The results showed that no matter what kinds of package, as soon as tea was packed, tea quality will continues to decline. But heat-sealed package combined with deoxidizer compared to the other package methods, it can effectively suppress the generation of bad flavors such as stale and rancid to slow down tea's flavor deterioration. Volatile compounds were affected by packaging conditions and changed over time. In order to find out the volatile compounds that caused the deterioration of the flavor during storage, we picked up 32 kinds of volatile compounds from data,

which were speculated that it may be the key factor causing the peculiar smell of tea's flavor. Further according to the results we selected 11 kinds of volatile compounds, which can be used as biomarker to distinguish the freshness of tea. Including 2-Methyl-3-pentanone, 3-methyl-2-Butenal, 3-Ethylcyclopentanone, (E,E)-2,4-Heptadienal, 1H-Pyrazole,4,5-dihydro-5,5-dimethyl-4-isopropylidene, 3,5-Octadienone, Methyl ester octanoic acid, 2,2,6-Trimethylcyclohexanone, Methyl nonanoate, 2-Butyl-2-octenal, 6,10-Dimethyl-5,9-undecadien-2-one.

**Key words:** Package, Storage, Volatile compound, Small leaf black tea

## **Effects of Different Packages on the Quality and Related Compounds of Honey-flavor Black Tea during Storage**

Meng-Chin Hsiao   Siao-Yi Huang   Hsuan-Han Huang  
Shih-Kai Lo   Jian-Hsing Shiau

### **Summary**

In this experiment, the honey-flavor black tea were packaged in three different methods, including vacuum aluminum bag combined with deoxidizer (vacuum packaging), sealed aluminum bag (sealed packaging) and aluminum bag with sealing clip (clamp packaging), went to sensory evaluation and compound analysis during storage. The honey-flavor black tea taste of vacuum packaging had stale flavor until 30 months storage. The honey-flavor black tea of sealed and clamp packaging appeared seriously miscellaneous and stale flavor after 6 month storage and clamp packaging appeared woody flavor after 12 months storage. Aroma component analysis found less volatile components but most with good aroma when honey-flavor black tea using vacuum packaging, and more volatile components with bad aroma when honey-flavor black tea using sealed and clamp packaging. Based on the test results of sensory evaluation, tea liquor color measuring, aroma and chemical compound analysis, it was recommended that honey-flavor black tea should be stored in vacuum aluminum bag combined with deoxidizer. The best expiration date is recommended 6 months because stored in this way there was no change in the test results. And the shelf life of honey-flavor black tea is recommended to be set at 24 months, because after more than 24 months of storage in this way, the stale flavor began to appear, and the aroma compounds were greatly reduced.

**Key words:** Honey-flavor black tea, Storage, Volatile compound, Package, Expiration date