Effects of Flowering on Yield and Quality in Tea Plant

Chui-Feng Chiu Teh-Ming Chu

Tea (Camellia sinensis (L.) O. Kuntze), one of the perennial industry crops, is cultivated by plucking its young leaves. The growth, yield and quality of leaves might be decreased due to the overproduction of flowers. Two tea cultivars, TTES No.12 and Chin-Shin Oolong, were selected for this experiment. The flowers were hand thinned in order to find out how flowering would affect the production and quality of the tea.

The experiments results showed that there were considerable quantity of flowers and buds on both TTES No.12 and Chin-Shin Oolong. The tea stems were treated with U-14C sucrose to study the uptake and distribution of photosynthates. It was found that 17.8% of the total uptake in TTES No. 12 was distributed to the flower buds; while in the case of Chin-Shin Oolong it was 80.3%. Over half of photosynthates in Chin-Shin Oolong were provided as nutrients for reproductive growth. Thus, it is concluded that during the flowering period, most photosynthates will be transferred to reproductive growth, and those to the vegetative growth are relatively reduced, which further leads to the decrease in the growth of tea plant and lower sprouting percentage or growth rate in tea bud, eventually reducing the production of the tea. The quality of the tea the year following thinning is apparently affected. In both tea cultivars, the tea quality of the thinning treatment is superior to the control in tea appearance, color of liquor, aroma or flavor.

Key words：Tea, Flowering, Photosynthates, Growth, Yield, Quality

Preliminary Study of Natural Out-crossing in Isolation Location for Tea Cultivars

Tie-Chung Lee Meei-Ju Yang Ching-Kuang Chang Iou-Zen Chen

The objective of this study was to investigate the feasibility of self-incompatibility for producing out-crossing seeds in a tea-breeding program. The results obtained are as follows：

1. The highest self-pollinated fruit rate was 3.86% among these 14 tea cultivars, but most of them were lower than 1%.
2. It was found that more than 60% of flowers were out-crossing for TTES No.12 and Chin-Shin Oolong, which were planted in three isolated locations.

The results of this study suggest that it is possible to produce out-crossing seeds from two or more tea cultivars grown in isolated locations.

Key words：Self-incompatibility, Self-pollination rate, Isolation location, Tea

The Assessment of the Morphological Variation and AFLP Marker Analysis in the Chin-Shin-Oolong Tea Cultivar in Taiwan

Hsien-Tsung Tsai I-Chen Tsai Wen-Ru Liaw Ching-Kuang Chang Yue-Wen Wang

Tea tree is a perennial species propagated mainly through vegetative methods. The morphological characteristics are subject to environment and cultivation practices and thus variations have been

observed. The distinguishable morphological differences have been documented in literatures and yet they failed to offer genetic explanation. Chin-Shin-Oolong is the most important tea cultivar in Taiwan and accounts for more than 50% of the acreage of the tea plantation. The variety was originated from Mainland China and introduced by Lin, Fong-Tsu in the form of a plantlet in 1855. It was selected among with many other lines in 1910 in the Pin-Chun Tea Experiment Branch Station and formally released to the public.

This research was intended to address the morphological variation using DNA marker technology to provide a genetic explanation. Thirty leave samples from the primary Chin Sin Oolong plantations around the island were collected and the DNA polymorphism among the samples was analyzed with AFLP marker system. The result revealed an average of 8% of DNA polymorphism among the 30 samples, which is greater than the amount of variation caused by mutation alone in general. There was a sample that had much greater diversity with the rest of samples and reached the magnitude of 44% of DNA difference. The morphological difference of this sample is less than the one revealed by DNA fragments. The result from this sample provides evidence of the genetic contribution of the variation. The DNA difference estimated for this sample was assumed to have been compromised by other factors during the expression of morphological traits. It was concluded the morphological difference among the Chin Sin Oolong tea samples in this study has genetic basis and the source has yet to be identified.

Key words：DNA marker, Chin-shin Oolong, Tea, Genetic analysis, AFLP analysis, Genetic diversity

Study on Drought Injury and Its Effect on Tea Production in Hualien and Taitung in 2003

Hun-Yuan Cheng Horng-Jey Fan

This study is aimed at understanding the cause of drought injury and its effect on tea tree（Camellia Sinensis（L.） O. Kuntze）production in Hualien and Taitung in 2003. The first objective is to elucidate the direct and indirect factors causing drought injury on tea trees, and then explain its situation in 2003. The final objective is to estimate the effect of drought injury on the yield in this and the next tea season. The results of this study showed that the primary factor causing drought injury was due mainly to the abnormal weather without rainfall for a long period time. This, in combination with high temperature and solar radiation, was determined as the major factors to cause drought injury. To a lesser extent, soil conditions acted as an indirect factor contributing to the drought injury. In addition, the results showed that a non-natural factor such as poor field management aggravated the seriousness of drought conditions in the production of Chin-Shin-Oolong, especially on weak trees in older tea gardens. Also, the results indicated that trees with strong growth demonstrated higher drought resistance; thus the germplasm is worthy of development for further utilization. Due to the lack of field data on long term monitoring of drought injury on tea trees, a reliable estimation of its effect on yield decline on tea trees is difficult. Therefore it is necessary to establish experimental plots for testing drought tolerant cultivars. It will enable the integration of information on natural disasters and their related meteorological conditions and its effect on tea production. Ultimately, a new, innovative measure can be developed to enhance

the drought prevention techniques in tea gardens.
Key words：Tea garden, Tea tree, Drought injury, Abnormal weather, Yield decline

Effect of Foliar Spray Urea on Nitrogen Fertilizer Requirement and Quality of Tea

Chun-Ming Tsai Shu-Mei Lee Iuo-Zen Chen Ching-Kuang Chang

Four foliar urea spray treatments, which included 1% and 0.5% urea were applied both twice and once during bud bursting, combined with three soil application ratios of nitrogen fertilizer, which included 450 kg/ha, 337.5 kg/ha and 225 kg/ha, were used in this experiment. There were no significant differences in yield and tea quality. However bush growth and numbers of flowers of ‘Chin-hsin Oolong’ were significantly affected by the treatments. Yield of TTES No.12 was significantly affected by foliar and nitrogen rates. Treatment of foliar application of urea associated with 337.5 kg/ha soil application nitrogen fertilizer had the highest yield. Bush growth and numbers of flower also affected by foliar application of urea associated with 337.5 kg/ha soil application. In conclusion, once or twice foliar application of urea should reduce at least a quarter of soil dressing nitrogen fertilizer.
Key words：Tea, Nitrogen fertilizer, Foliar application

Breeding Report of Two 2004 Registered New Tea Cultivar TTES No. 19 and 20

Chun-Ming Tsai Ching-Kung Chang ou-Zen Chen Kuo-Renn Chen You-Zenn Tsai Chwei-Fong Chiou Jin-Chih Lin Horng-Jey Fan

Seventeen-selected clone, which were hybrid in 1938, were pollinated with the pollen of ‘Chin-Shin-Oolong’ in 1962, and 523 seedlings were obtained in 1963. After nursery selection, a new individual test new line test and regional test, two line, 51-14 and 51-67, were named as ‘TTES No. 19’ and ‘TTES No.20’ on 9th January 2004. Both of them are for Paochung tea and belong to the mid-season cultivar. ‘TTES No. 19’ has light green shoot tip with middle dense of leaf hair, oval to oblong shape mature leaf, strong vigor, less drought resistance, middle to high yield, spring tea harvest date is slightly later than ‘TTES No. 20’. The tea made from ‘TTES No. 19’ had shining green color, blight and honey green liquor with elegant flavor and sweet taste. According to the data in the regional test, ‘TTES No. 19’ is suited for middle to high altitude tea plantations. ‘TTES No. 20’ has a purplish green shoot tip when the bud just burst then turn blight green, leaf hair is denser then ‘TTES No. 19’, almost oblong shaped mature leaf, bud burst very uniform, strong vigor, less drought resistance, high yield but the lignification of fresh leaf is very fast, so it had a short harvest period. The tea made from ‘TTES No. 20’ had shining green color, blight and honey green liquor with good aroma and strong taste. According to the data in the regional test, ‘TTES No. 20’ is suited for middle to low altitude tea plantations, and should avoid humidity and poorly ventilated areas, and take care of Blister blight and Brown blight.
Key words：Breed, Cultivar, Hybridization, Yield, Quality, Drought tolerance

Experiments of Leafhopper-sucked Tea Shoot Manufacture

Huey-Tzang Chen Sang-Shung Wu Shin-Yan Chen

Leafhopper（Jacobiasca formosana Paoli）, is a kind of annual pest, generally found in Taiwan tea gardens. Under threat of pests, other than a lower yield of tea; it would cause harmful influence on the quality of tea products, especially the light-fermented Paochung that possessed the characters of aroma and taste. So tea farmers would invest more time and money in chemicals to prevent tea production from pest damage.

Traditionally, the tea shoot, which was injured by leafhoppers, was the main material manufacturing for Bai-hau Oolong. This study was conducted to manufacture different teas, and to evaluate, organoleptically, the aroma of those products. We found that among those evaluated, green and black teas were suitable for commercial development, because of their honey-like fruit flavor, easier process procedure, and lower production costs.

Leafhopper-sucked tea shoots were utilized as materials for manufacture of green and black teas. The procedures were slightly different from the traditional method. Those green and black teas were possessed special honey-like fruit flavor, were denominated as “Taiwan Honey Flavor Green Tea” and “Taiwan Honey Flavor Black Tea”.

With the leafhopper-sucked tea shoots as the raw materials, it could decrease the utilization of insecticides and pesticides, and lower environmental pollution and farmland impairment. Accordingly for those reasons, it could be beneficial to popularize organic tea products, and raise the additional worth such as the sustainable use of farmland.

Key words：Bai-hau Oolong, Taiwan honey flavor Green tea, Taiwan honey flavor black tea, Leafhopper

Monitoring of Major Tea Pests and Diseases in Eastern Part of Taiwan

Suh-Neu Hsiao Jian-Hsing Shiau

The population fluctuation of important tea pests and diseases was monitored at Luye, Taimali and Ruisui, in the eastern part of Taiwan from 1999 till 2002. Results showed that the die-back disease (Macrophoma theicola Petch) was found every month. The occurrence frequency for other pests and diseases including tea leaf hopper (Jacobiasca formosana Paoli), citrus spiny – blackfly (Aleurocanthus spiniferus (Quaintance)), tea tortrix (Homona magnanima Diaknoff), smaller tea tortrix (Adoxophyes sp), red spider mite (Oligonychus coffeae Nietner), tea mosquito bug (Helopeltis fasciaticollis Poppius), yellow thrip (Scirtothrips dorsalis Hood), Kanzawa spider mite (Trtranychus kanzawai Kishida) and brown blight of tea (Glomerella cingulata (Stonem) Spauld & Schrank) was 88.2%, 81.1%, 80.7%, 75.5%, 42.1%, 34.1%, 16.1%, 5.1%, and 4.8%, respectively. Tea pests and diseases occurred more seriously in 2002 than the other three years. Generally, the population density of leafhopper was high from May. It was occurred more seriously in Taimali than the other two districts. Citrus spiny-blackflies occurred more seriously in Luye than the other two districts and the adults appeared in April, June, August and October. Smaller tea tortrix and tea tortrix infested more seriously in 2002 than other previous years and were more serious in Luye.

Tea mosquito bugs occurred during two periods, May to June and August to September, in Taimali. Red spider mites occurred more seriously in Ruisui and appeared seriously during April to May and July to September. Die-back disease was very prevalent in Luye with significant damage (83%) in late April in 2002.

Key words：Eastern Taiwan, Tea pests and diseases, Population fluctuations

Study on the Flavour Quality, Appearance and Liquor Color of Bai-hau Oolong Tea by Different Shaking Times

Kuo-Renn Chen Chun-Liang Chen

The object of this research is to understand the withering and shaking effect on the tea fermentation, appearance of tea, and the change of liquor color, so that may help us to judge the flavour quality and grade the tea.

Experimental results showed that there were significant differences in appearance, liquor color（a, b, Δ E value）, flavour and taste of the tea made from different shaking times. The a value and b value increased by the shaking times, which means that the green components decrease and the yellow components increase. Sensory evaluation revealed that the shaking five times treatment gave the best quality of tea liquor, and the shaking four times was the second ranked. The b value showed high correlation with the results of sensory evaluation.

By understanding the withering and shaking effect on tea fermentation, appearance of tea, and the change of liquor color, it may help us to judge the flavour quality and grade the tea.

Key words：Tea, Chin-shin Dapang, Sensory evaluation, Bai-hau Oolong tea

Comparison of Catechins Contents and Antioxidant Activity of Green Teas from Taiwan Major Tea Cultural Cultivars

Yung-Sheng Tsai Shih-Lun Liu Hsueh-Fang Wang Shau-Mi Ou

Using pan-fried green teas made from nine major tea cultural cultivars (Chin-Shin Da Pan, TTES No.12, TTES No.13, Si-Ji-Chun, Chin-Shin Oolong, Chin-Shin Gan Zai, TTES No.7, TTES No.8 and TTES No.18) in spring, summer and fall seasons in Taiwan as experimental materials, their contents of catechins and antioxidant activities were examined. The purpose of this study was to compare the differences in catechin contents and antioxidant activity among these tea samples as well as the correlation between the catechin contents and antioxidant activities. The results show that the total catechin contents of green tea samples from these nine tea cultural cultivars ranged from 6.62% to 21.79% and the average amount was 12.72±3.32%. Among six individual catechins, the contents of EGCG and EGC were the highest with average above 70% of total catechins. The differences in catechin contents among all tea cultivars were not significant except for the difference between large-leaf-type (TTES No.7, TTES No.8 and TTES No.18) averaged as 16.1% and 6 small-leaf-type ones averaged only 10.45% ($p<0.05$). They differed by more than 50%. The catechin contents of summer green tea samples were significantly higher than those of spring and

fall ones. The contents of two free types of catechins (EC and C) in TTES No.7 were found to be very high. It made the catechin profile of TTES No.7 differ from those of other tea cultivars. Using four different methods to evaluate the antioxidant activities of green tea samples from these nine tea cultural cultivars, it was found that only the TEAC method could detect the antioxidant activity of large-leaf-type ones better than that of small-leaf-type ones. The concentration of tea samples used in this study was very low at only 1% (1 gm tea in 100 gm 100℃ water), but they all showed considerably high antioxidant activity (>40%). This indicates that the antioxidant activity should be even higher when we are drinking tea because the concentration of tea is usually at least as 2% (3 gm in 150 mL 100℃ water). In terms of correlation analysis of catechin contents and antioxidant activity, the results show that only TEAC was positive-related significantly to EC, ECG, TCG (total ester-type catechins) and TC (total catechins). The antioxidant activity evaluated by the other three methods showed no significant relationship with the catechins ($p>0.05$). It should probably be pointed out that the components other than catechins (like polyphenols) also affect the antioxidant activity.

Key words：Green tea, Tea cultural cultivars, Catechins, Antioxidant activity

Characteristics of Taiwan Tiehkuanyin Tea Identified by Physicochemical and Stepwise Discriminant Analyses

Shih-Lun Liu Yung-Sheng Tasi Kuo-Renn Chen Shau-Mei Ou

A total of 34 Tiehkuanyin tea samples of different grades were selected as materials from the competition of Tiehkuanyin tea in MuCha. The major physicochemical constituents of Tiehkuanyin tea samples were analyzed and compared to establish the basic constituent profile of Tiehkuanyin tea produced in Taiwan. Three different grades of Tiehkuanyin tea were used to find out the difference in the physicochemical constituents among them. Stepwise discriminant analysis (SDA) was used to assist in discriminating the three different grades of Tiehkuanyin tea. The results showed that the low pH, very low free amino acids content but high total ester-type catechins content were characteristic of Taiwan Tiehkuanyin tea. Most of the physicochemical constituents among the three grades of Tiehkuanyin tea samples differed significantly, but there were no analogous tendencies among grades. The results of SDA showed that five variables were selected by SDA among three grades of Tiehkuanyin tea samples and the total error percentage was 11.76 %.

Key words：Taiwan Tiehkuanyin tea, Major physicochemical constituents, Stepwise discriminant analysis

Influence and Prospect of the Development of Tea Art Culture on Society and Tea Industry during Past Three Decades

Cheng-Nan Lai Yei-Fei Su

Taiwan tea art culture began to flourish at the same time as the initiation of famous tea contests and propaganda about tea drinking in 1975. Tea art cultures not only could purify the humanistic nature

of people, but could also teach the participants to realize the silent sacrificial virtue of tea and the life philosophy of “first labor, then enjoy later”. Henceforth, many kinds of information of tea art culture were continuously published. Some tea lovers and tea dealers stepped in and followed one another to establish private organizations for promoting tea art culture. They coordinated with related government units to conduct many promotional activities which was to benefit tea art culture and also tea marketing. To survey the future development of tea art culture, government has actively extended many cultivation &manufacturing technologies, domestic & foreign promotions, and also has synchronized with private organizations to conduct many promotion activities. Although tea art culture is facing some negative impact after Taiwan’s entrance the WTO, it still has potential space for development.
Key words：Tea., Tea art culture, Tea culture