

Selection of Winter Green Manure Crops for Low Altitude Tea Gardens

Meei-Ju Yang Ching-Kuang Chang Chin-Ko Shih

The superior winter green manure crops to be planted in low altitude tea gardens are ryegrass (*Lolium multiflorum* Lan.) and lupine (*Lupinus luteus* L.). Although at their growth season they affect the yields of tea, they can improve the surface soil and the subsoil environment efficiently, without affecting the quality of tea or numbers of insects. Moreover, if we want to increase more efficiently the pH value, organic matter and mineral content of subsoil, we can planting vetch (*Vicia dasycarpa* Ten.) which has long root systems that improve soil properties of the subsoil.

Key Words : Tea garden, Green manure, Soil, pH value, Organic matter, Mineral elements

Effect of the foehn on the Growth and Protection of Tea Tree

Meei-Ju Yang Ching-Kuang Chang Chin-Ko Shih

This study summarizes the effect of foehn on the shoot growth, injury symptoms, production, manufacture quality and protection of tea trees (*Camellia sinensis* (L.) Kuntze) in the Taitung tea districts during 1989-1999.

Foehn occurs in spring, summer and autumn tea season. The summer tea season had the highest occurrence rate of 49%. The injury symptoms appear as leaf droop, dryness of leaf apex, leaf margin, leaf stalk, internode and inhibited growth of tea shoots. After grading the injury symptoms, the injury grade score had highly significant positive correlation with maximum wind speed and foehn duration time. The tea trees suffered very heavy injury by typhoon-induced foehn in summer and autumn, with the tea production and manufacture being heavily affected. Lighter injury of tea trees appeared with monsoon or strong air-current induced foehn, and sprinkler irrigation could decrease tea shoot injury ratio. The protection method from foehn included attention to typhoon forecasts before foehn happens and increased irrigation equipment of tea garden. When foehn dose occur, the best way to protect tea trees was by using sprinkler irrigation to increase relative humidity and decrease air temperature. After the foehn, injured tea trees need shoot pruning, fertilization, tea tree vigor restoring, and early plucking to aid recovery. Using hot wind withering and air condition machine could overcome climatic stress at tea factory.

Key words : Tea garden, Green manure, Soil, pH value, Organic matter, Mineral elements

Effect of Damage Caused by Smaller Green Leafhopper (*Jacobiasca formosana* Paoli) on Shoot Growth and Chemical Components of Tea Plants (*Camellia sinensis* L. Kuntze)

Jian-Hsing Shiao Teh-Ming Chu

The young tea shoots of Chin-Shin Oolong and TTES No.12 were infested by smaller green leafhopper with one adult per shoot in the net cages. After 10 days infestation, agronomic characters of shoots were investigated and chemical components of tea leaves were analyzed. Results indicated that the diameter of 1st internode, and the length of 1st and 2nd internodes of shoot were

significantly shortened. The fresh and dry weight of 100 shoots were decreased by 22.8% and 23.2% respectively, by the infestation of the smaller green leafhopper. These affects were most significant in spring tea, and the damage degree of Chin-shin Oolong affected by smaller green leafhopper was higher than TTES No.12. Chlorophyll, soluble sugar, total free amino acid and water content were decreased. In addition, soluble solid, polyphenol, catechin and caffeine content were increased by insect damage.

Key words : *Jacobiasca formaosana* Paoli, *Camellia sinensis* L. Kuntze, Agronomic character, Chemical components

The Study of Producing Cross-Pollinated Seeds of Tea in the Net Chamber by *Chrysomyia megacephala*

Meei-Ju Yang Tair-Chyang Lee Hsin-Kuang Tseng Ching-Kuang Chang

The pollination parents of tea trees were separated from the outside by net chambers. After their flowers opened, *C. megacephala* were put into the net chamber to help pollination. The results reveal that the fruiting rate of cross-pollination was higher by using *Chrysomyia megacephala* than by hand. Furthermore, every flower has the chance to be pollinated, instead of only 1 to 2 flowers per shoot, as in hand pollination; so the efficiency of pollination by insect pollinators in the net chamber was better than by hand. The fruiting rates of the two tea trees of the same cultivar in the net chamber were below 1%, so that when we produce hybrid seeds by insect pollination, we can put more tea trees in the net chamber to increase the number of seeds.

Key words : net chamber, Insect pollinator, Pollination, Hybrid seed

The Effect of The Green Lacewing, *Mallada basalis* (Walker) on the Red Spider Mite, *Oligonychus coffeae* Nietner in Tea Plantation

Sue-Neu Hsiao

Green lacewings, *Mallada basalis* (Walker) were reared en masse mass in the laboratory for collecting their eggs. When the larvae had just hatched, the eggs and the hatched larvae were released to a tea plantation immediately once a week. The first test showed that the effect of releasing 33.3 larvae of green lacewings per tea tree was better than the effect of releasing 18.9 individuals on the red spider mite, *Oligonychus coffeae*. The control rate for the mites and eggs of the former was 85.2% and 88.9% after releasing the green lacewing twice. After release five times, the density of the red spider mites was reduced from 7.61 individuals to 0.79 individuals per leaf, and the control rate of the mites and eggs was 98% and 96.9% in the treatment of releasing 33.3 individuals. The ratio of population density of mites and the green lacewing released per tea tree was 1:8.8. However, release seven times was required in the treatment of releasing 18.9 individuals when the population density of mites was reduced from 7.35 individuals to 0.94 individuals per leaf. And the ratio of population density of mites and the green lacewing released per tea tree was 1:4.7. The second test showed that the population density of red spider mites was reduced from 31.18

individuals to 4.07 individuals per leaf after release six times with 332.2 individuals of the eggs of green lacewings per tree each week. And the control rate for the mites and the eggs was 87.9% and 80.3%. The ratio of population density of mites and the green lacewing released per tea tree was 1:10.6. The test showed that the more lacewings were released, the faster control was achieved. When the density of the red spider mites was high, more release times and individuals were needed. Key words : Red spider mite (*Oligonychus coffeae*), Green lacewing (*Mallada basalis*), Biological control

Effects of Setting Time during Indoor Withering Period on the Change of Catechin Contents and Caffeine during Manufacturing Process of Paochung Tea

Chih-Jen Lee Cheng-Hung Cheng

In this experiment the content of catechins and caffeine of fresh leaves were (-)EC 3.57 mg/g d.w., (-)EGC 53.75 mg/g d.w., (-)EGCG 52.84 mg/g d.w., (-)ECG 4.82 mg/g d.w., total catechins ((-)EC, (-)EGC, (-)EGCG and (-) ECG) 114.99 mg/g d.w. and caffeine 14.37 mg/g d.w.. Under normal Paochung tea manufacturing process, the content of catechins decreases during indoor-withering period, with the lowest content of catechins observed at the step before panning. However, caffeine remains steady during tea manufacturing process. During the indoor-withering period setting time after the third and fourth times shaking, there was more effect on the change of catechins than in the first and second times. The shorter setting time after the third, fourth shakings increased the contents of total catechins, (-)EGC, (-)EGCG, (-)ECG, but did not decrease in the step before panning; and also the contents were significantly higher than the other two treatments.

Key word : Indoor withering, Setting time, Paochung tea, Catechins, Caffeine

Effects of Withering Temperature and Humidity on the Quality of White Tea (IV) Effect of Chemical Components on the Quality of White tea

Jin-Chin-Lin Shih-Shiung Chen

Stepwise regression analysis showed that qualities of white tea were affected by chemical components in the following equations:

Color(\hat{y})=3.132+2.219pH-27.654Pro+14.497Glu+22.85Ala+0.107Soluble solids+13.018Asp-34.927Gln (R²=0.858)

Aroma(\hat{y})=3.132+2.219pH+1.176Glu-10.054Ala+14.043Leu(R²=0.776).

Flavor(\hat{y})=-4.388+3.469pH-12.728Ala+0.281Total amino acid(R²=0.743)

Overall(\hat{y})=-24.590+14.804pH+28.816Glu-120.784Pro+32.874Ser(R²=0.895).

In these regression models, pH, glutamate, soluble solids, aspartate, leucine, serine, and total amino acids showed positive effects on the quality of white tea; whereas alanine, glutamine, and praline showed negative effects. Among them, pH and glutamate are the two most important factors to influence the quality of white tea, and both the determination coefficients are higher than 60%. Withering under low temperature and high humidity tended to increase pH, soluble solids,

glutamate, aspartate, leucine, and serine; but decrease alanine and praline contents in tea infusion, which enhanced the quality of white tea.

Key words : white tea, Chemical components, Withering, Temperature, Humidity, Quality

Prospective of Bioelectric Nose Uses for Monitoring Withering and Shaking Process of Paochung Tea

Jyh-Shyan Tasy Tzeng-Zeng Wu Wei-Chin Chang

The withering process of Paochung tea, which influences the quality of tea product, is time-consuming and highly dependent on experience. The design of our experiment was to evaluate the possibility of using a bioelectric nose as the index for the Paochung tea withering process. Twelve bioelectric nose probes including HAC01, OR5, OS10, OS9, OR4I05, A7N, A5N, A6N, DH31, HAC02, MAA and AIN were screened from 36 probes to be tested as the index of withering process. Changes of aroma in the withering process were detected by biosensors, hierarchical cluster analysis showed the aroma before and after the 1st shaking, after the 4th shaking and before panning was similar, so it could be the monitor index of the withering process, in combination with artificial neural network analysis software. When the end point of the withering process was determined by an A5N biosensor probe (difference of frequency) and by experience of technician, the results were comparable. There are many factors that influence tea manufacturing quality, so the establishment of a detailed database is necessary to use a bioelectric nose for the index of tea flush in the withering process. In addition, the specifications of the bioelectric nose for specific aromas need further improvements for practical application.

Key words : Paochung tea, Bioelectric nose, Piezoelectric quartz, Withering process, Aroma

Development and Improvement on the Far-Infrared Roasting Machine of Tea

Jin-Chih Lin Kuo-Renn Chen Lian-Fua Chang Yung-Sheng Tsai

This project proposes new types of far-infrared roasting machines for tea processing, as well as the installation of far-infrared heating machines on old type tea-roasting machines to improving tea processing facilities. It also determines optimum roasting conditions for tea processing. Infrared ray and TEFLON coating treatments had significantly lower pH values of the resulting tea soup. The lower pH value for the TEFLON coating may be related to the higher emanation rate of that material. Results from overall sensory evaluation also revealed that the infrared ray treatment gave the best quality of tea soup, and the nitrification treatment had the ranked second. As the roasting temperature was increased or roasting duration was extended, the tea liquor was significantly decreased in Land a values, whereas the b and ΔE values increased. Compared to products from traditional roasters, teas produced with 3 types of infared ray machines had significantly lower phenolic compound and less astringent taste. With higher free amino acids and reducing sugar, better taste and sensory quality, the bamboo ware treatment had best effects among 3 types of treatments. Also, darker tea soup was found in 3 types of infrared ray treatments. The new type of infrared ray container had the most significant effect, indicating revealed the possibility of shorting

the duration of roasting to improve the processed quality of tea.

Key words : Far-Infrared heating, Roasting, Paochung tea

Effects of Irrigation Juncture on Soil Temperature and Shoot Growth of Tea Plants

Teng-Feng Huang Yeun-Kung Chang Chien-Min Huang

Atmosphere temperature changes greatly in the middle and high elevation tea areas of Taiwan, and especially in the growing seasons for spring and winter crops, These areas often sec drought. Tea irrigation is the most commonly available method to maintain the growing vitality, and this study compares the influence on shoot growth of irrigation in the morning or in the afternoon.

During the growing season for spring crop, the water temperature in the reservoir was 2-4°C higher than the soil temperature which was not irrigated, with a larger temperature difference in the night and a smaller one in the daytime. When tea field was irrigated, the water temperature might help to increase the soil temperature, and because the specific heat of water is higher than soil, the decrease of soil temperature at night might not be less. Irrigate in the afternoon produced smaller leaf numbers of 1 bud 1 leaf to 1 bud 4 leaves, although the average weight of shoots was larger than with irrigation in the morning. Thus, a positive influence on tea shoot growth by irrigation in the afternoon was obtained.

Within the growing season of winter crop, the water temperature in the reservoir is more steady and higher than the soil temperature which is not irrigated. The irrigated soil temperature was 2-3°C higher than the soil temperature which was not irrigated and the difference of the soil temperature between irrigated and un-irrigated treatment in the night became smaller. The number of 1 bud 1 leaf to 1 bud 4 leaves was found larger for the irrigation in the afternoon than the irrigation in the morning, and the average weight was larger for the treatment of irrigation in the afternoon. Thus is suggest that irrigate in the afternoon is also better for the winter tea crop.

Key words : Tea, Irrigation juncture, Soil temperature

A Case Study on the Managerial Strategies of Farming Commercialization for the Tea Production and Marketing Group---The 1st Class of Tea Production and Marketing Group at O-Mei

Wen-Ru Liaw

With Taiwan set to become a full member of the WTO (World Trade Organization) in 2002, the central and provincial government units have promoted guidance for the agricultural production and marketing groups since April, 1993. The main goal is to help those groups generate strategic options that will be responsive to changes facing the challenge of competition from form agricultural products from others countries. A total of 267 tea production and marketing groups had been set up, with 5,009 members and 5,776 ha of tea plantations, by December, 2001. Although this project now has preliminary results, how to help these groups move toward farming commercialization is very important.

In order to develop strategies based on sustainable competitive advantages of each tea farming

group, the tea farming group should consider both the external and internal environments. Externally, they should consider changes, trends, threats and opportunities, and then create responsive strategies. Internally, they should identify organization strengths and weaknesses. This study is a case of the 1st Class of Tea Production and Marketing group at O-Mei, providing some managerial approach to the farming commercialization of these tea farming groups. This 1st Class of Tea Production and Marketing group at O-Mei was guided from 1999-2001 year, and the results can be seen in the increased annual sales, from 9,000,000 NT dollars before guidance up to 19,270,000 NT dollars after three years of guidance.

Key words : Tea, Agricultural production and marketing groups, Farming commercialization, Managerial strategies

Botanical Inventory on Mau-Lan Mountain Area Set on Nan-Tou Near Yu-Chih Substation of TTES Fei-Shuang Hsu Bi-Kuei Tsao

The Mau-Lan Mountain area, especially the Yu-Chih Substation of TTES near Sun Moon Lake, is well known for its famous scenery and Assam black tea. The vascular plant flora comprises 122 families and 491 species. The botanical inventory surveys the botanical ecology and the relation between the land resources and black tea shrub.

The important plant pattern includes: (1) Tea farm indicative plants. (2) Weeds on the middle of Taiwan. (3) Wild or endemic plants of Taiwan or Mau-Lan Mountain. (4) Important vine plants. (5) Main crops.

The relation and the dynamic balance pattern between the flora and black tea plantations is the result of different management of the tea plantations.

This study can be used to compare the different flora and plant resource over the next 10 years.

This study considers the relation between the crops and ecology.

Key words : Black tea, Ecology. Flora, Plant resource

Application of Delphi and Tee Chart on Micro Tea Climate Research Chien-Min Huang Teng-Feng Huang Yeun-Kung Chang

Previously, the collection of micro tea climate data was expensive, difficult and time-consuming. Now, using micro-sensor and modern computer techniques, the collecting of micro tea climate data is less expensive and more convenient. However, special programs still need to be developed to translate the source formatted sensor data into an adequate structural system Data Base, and specially designed programs are needed when performing calculation, statistical or graphic work. This article reports on the use of Delphi language and tee Chart component to write a special application program to handle the translating, sub-dataset choosing, statistics and graphics. With this application program we can combine sensors, PC, multi-tier structure, and network for micro tea climate research.

Key words : Macro tea climate, Micro tea climate, Sensor, Structured Query Language

Studies of Tea Grading and Packing Methods

Sheng-Shiun Yang

Recently, Taiwan tea markets are subject to particularly strong competition due to the recent rapid increase the popularity of tea-drinking. Since variations in tea quality and in price are so great, many customers are confused. In order to raise the customer's confidence of Taiwan tea, Taiwan Tea Experiment Station has cooperated with related units to actively assist with grading and packing of tea as well as the establishment of label systems. Some units, including Farmers' Association, Tea Production Cooperative Group, and some tea production and marketing groups, have conducted grading and packing of tea products, winning a very high appreciation from customers.

We had obtained customer's responses on the improved grading and packing through the analysis of questionnaires. These results are at following:

1. The ratio of more confidence and no confidence for grading and packing tea products are 61% and 39%, respectively.
2. Since grading and packing labels tea products are very complicated, the ratio of endorsement for using same label in every tea estate is 53%.
3. About 63% of the customers believe that famous tea contests could promote the tea sales.
4. Customers believe that famous teas after contests which were sold through separate packing and blending packing are 47% and 39%, respectively.
5. 64% of customers who believe that famous teas were sold after blending and uniform packing have difficulty.

Key words : Grading and packing tea products, Tea production and marketing groups, Famous tea contests

The Susceptibility of Cultivars of Tea Plants (*Camellia sinensis*) to Die-Back Disease

Fang-Ming Thseng Kuen-Long Chen Jee-Song Chen

There were quite differences in the degree of the susceptibility to die-back disease in 104 cultivars of tea plants (*Camellia sinensis*) in the tea cultivars garden of Taiwan Tea Experiment Station, Chin Shin Oolong was the serious one to die-back disease. The 40 cultivars including Wu Jin etc. belonged to the medium susceptibility in correspondence to the light susceptibility of the four cultivar including Guey Hua. The resistant cultivars without any symptom in two years had 57 in total including Shen Mann Joong. Climate with dry and high temperature in 1998 made this disease more serious than that in 1999. Data showed that small leaf cultivars (*C. sinensis* var. *sinensis*) were more serious susceptible than large leaf cultivars (*C. sinensis* var. *assamica*). The resistance to die-back disease of tea plant was related to the cultivars gene and environmental condition.

Key words : Tea (*Camellia sinensis*), Cultivar, Die-Back disease, Susceptibility