

Study on the Variation of Agronomic Characteristics of Taiwan Native Tea Trees

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Summary

This research aims to understand the plant and shoot growth of Taiwan native tea trees during the tea season and the adaptability of cultivation on lowland, and to explore the variation of agronomic characteristics, so as to be used as a reference basis for germplasm conservation and evaluation, development and utilization, and selection of breeding materials. This experiment was conducted in the Lungteng, Luyeh district, Taitung (22°54'37" north latitude, 121°07'25" east longitude, 175 m above sea level) from 2004 to 2009. Investigation and analysis of the ten years old tea tree variety garden in the Taitung branch, TRES. The Taiwan native tea trees that participated in the experimental investigation include Shan cha, Mei Yuan native tea, De Hua She native tea, Fong Huang native tea, Long Tou native tea, Le Ye native tea, Nan Fong native tea, Min Ghai native tea, and Yung Kang native tea, with TTES No. 8 and TTES No. 18 for the control cultivars. The results showed that in different tea seasons, the growth of Taiwan native tea trees shoot growth most vigorously in the summer tea season. The shoot characteristics of Taiwan native tea trees and large-leaf cultivars were significantly difference, namely, internode diameter, internode length, leaf area, leaf thickness and leaf length/width ratio. The agronomic characteristics of different Taiwan native tea trees also show difference. De Hua She native tea, Long Tou native tea, Nan Fong native tea, Min Ghai native tea and Yung Kang native tea were strong and had good adaptability for cultivation on lowland and had development potential. We can continue to evaluate their economic cultivation benefits. Regardless of the tea season, the yield of Taiwan native tea trees was positively correlated with most of the shoot characteristics, but only a few characteristics were significantly. The coefficients of variation of shoot length, internode length, leaf area, bud density, 100 buds weight and yield of different Taiwan native tea trees and each tea season were greater than other characteristics, with the largest variation in yield.

Key words: Taiwan native tea tree, Agronomic characteristics, Yield

The Influence of Fertilization Rate, Growth Media and AMF Inoculation on the Growth and Nutrient Absorption of Tea Cuttings

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Summary

Mortality rate of tea seedlings might be high due to the high temperature, drought, and soil-borne diseases in summer. In this experiment, influence of fertilization rate, growth media and arbuscular mycorrhizal fungi (AMF) inoculation on the growth and nutrient absorption of tea cuttings were explored. This experiment was conducted in the green house of Tea Research and Extension Station (TRES), the test cultivar was TTES No. 12 and AMF was *Rhizophagus clarus*. Tea cuttings were treated with three fertilization rates namely 0.5×, 1×, and 1.5×. Under each fertilization rate,

there are 6 different treatments, i.e., (1) growth medium was red soil, (2) growth medium was red soil and inoculated with AMF, (3) growth medium was mixture of peat moss and perlite, (4) growth medium was mixture of peat moss and perlite, and inoculated with AMF, (5) after new root was initiated in the mixture of peat moss and perlite, cuttings were transplanted to red soil (PPRS, peat-perlite-red-soil), (6) after new root was initiated in the mixture of peat moss and perlite, cuttings were transplanted to red soil and inoculated with AMF. Fertilizer used in this experiment was Taiwan Fertilizer No. 1 (N-P₂O₅-K₂O = 26-13-13). Fertilization rate 1× was prepared by 400× dilution of Taiwan Fertilizer No. 1 and 30 ml of diluent was given each pot per week. The experiment results indicated that the plant height, shoot fresh weight, shoot dry weight, nitrogen and potassium contents of tea cutting shoots were mainly affected by fertilization rate and growth medium, while the root growth was mainly affected by the growth medium and AMF inoculation. The absorption of phosphorus of tea cutting plants was not only influenced by the fertilization rate and cutting growth medium, the cross interactions such as fertilization rate × cutting growth medium, fertilization rate × cutting growth medium × AMF inoculation were also significant. In this study, the cutting plants showed the best shoot growth in 1× fertilization treatment if compared with the others. Nevertheless, PPRS was the best cutting growth medium in all treatments. The *Rhizophagus Clarus* inoculated in this research exhibited a significant effect on promoting the root growth of tea cuttings, and a good symbiosis effect with tea trees.

Key words: Tea cuttings, Arbuscular mycorrhizal fungi (AMF), Colonization rate of AMF

The Study of Pesticide Reduction Technology in Tea Plantation

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Summary

In general, the pest management of tea gardens relies on the chemicals. The investigation showed that Taiwan tea gardens use 34.72 kilograms of chemical products per hectare per year in average. With the rise of environmental awareness and food safety issues, it is one of the most important issues to reduce the use of chemical pesticides. In this study, the tea plant diseases, insect pests and their control agents were grouped, and the local tea gardens were introduced for customized pesticide-reduction technology. The feasibility of the pesticide-reducing production management technology module was verified. This study took the four tea areas including Hukou Township in Hsinchu County, Wenshang in New Taipei City, Yuchih in Nantou and Meishan Rui-fan in Chiayi Counties as four examples. Adjust the amount of pesticides based on farmers' cultivation habits and the occurrence of diseases and insect pests. The result showed that there was no difference between the pests in the test areas and the control area. Hukou Township, Nantou Yuchi, Chiayi Meishan Ruifeng those 3 tea areas and 4 test areas have conducted pesticide residue detection tests on tea samples, with a pass rate of 100%. The tea pesticide residue detection results of test and control areas were all meet the national standards. Furthermore, the types of detected pesticides in the test area are less than the control area. There was no significant yield difference between the test areas and the control area. It showed reasonable pesticide reduction management can not only decrease the production costs, but also maintain yield. Moreover, it could produce safer tea raw materials, which

not only protects the environment but also protects the health of manufacturers and consumers. Through the overall evaluation of the implementation results of the 4 detailed plans of this plan, the current goal of the Council of Agriculture to reduce the use of pesticides by more than 30% has been achieved. One of the newly developed tea garden-friendly materials in this project is food grade acetic acid, which is used in tea gardens to test the weeding effect of tea rows and open spaces. It also tested its impact on the soil environment. And it was found that the use of a specific concentration of acetic acid can achieve more than 80% of the herbicidal effect and reduce the herbicide by more than 30%.

Key words: Tea, IPM, Pesticide, Herbicide, Pesticide reduction use, Use various pesticides in turn, Customized

The Study of Integrated Management Techniques for Green Mirid Bug in Organic Tea Plantations

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Summary

Green mirid bug (GLB) is a phytophagous pest in Taiwan's medium & high altitude tea plantations. Since 2016, outbreaks of the pest have been reported in Lala Mountain in Taoyuan City, Jianshi Township in Hsinchu County, and Zhushan Township in Nantou County, especially in organic tea plantations, which could cause 70% to 80% loss in severe cases. Due to the importance of food safety in agri-products and ecological sustainability, the technologies of Integrated Pest Management (IPM) and the natural, low-toxicity plant protection products have been used to replace chemical pesticides. In this study, we monitored population dynamics of GLB by the mean damage rates of fresh shoot of tea trees and the number of GLB attracted by light trap in spring. In the laboratory, we compared the feeding preferences of the GLB for eight common tea cultivars and three weed species, and preliminary screened plant protection products. Three potential plant protection products, four types of traps and three treatments with different concentrations of potassium fertilizer (grass ash) were further tested in the field to evaluate the effect on control GLB. The results showed that the mean damage rates of one-bud two-leaf could reach 37.70%, and the number of GLB attracted by light trap reached 20 (18:00-23:00 p.m.), which is a rising period for the GLB population in the field. In the presence of both tea trees and weed hosts, the GLB prefers yellow tubular flowers of *Biden pilosa* and one-bud one-leaf as food sources, and has a low preference for Sijichun. In the laboratory test, Hui-Yi-Qing pest control agent has better control potential, reducing the numbers and the areas of feeding spots by 42.80% and 53.96% respectively compared to control. After successive applications in the field, the mean damage rates of fresh shoot was 8.85% lower than control. Green sticky trap was the most effective trap (2 bugs/sticky trap). With the different potassium fertilizer treatments, the physical structure and accumulation of macronutrient in tea leaves were not stable and the application of grass ash had no significant control effect. The results of this study can be used to develop technical principles for IPM for GLB, including monitoring technique, control timing, ecological control, cultivation control, physical control, breeding for host resistance and selection of low-toxic control products.

Key words: Green mirid bug, Organic tea plantation, Integrated pest management

Effect of Different Extraction Conditions on the Extraction Rate of Anthocyanins from Green Tea Made from Cultivar-TTES No. 25

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Summary

Anthocyanins are water-soluble pigments that exist widely in many plants. In this study, different extraction conditions were used to determine the anthocyanins content in green tea made from cultivar-TTES No. 25 (purple shoot), and TTES No. 18 (green shoot). The analysis method of anthocyanins is the pH-differential method recommended by the Association of Official Analytical Chemists (AOAC). The results showed that using 50% acidified methanol solution and ultrasonic to extract the TTES No.25 tea leaves powder for 10 minutes, the total anthocyanins content is 0.33 mg/g, which was higher than that of acidified deionized water. There is no significant difference between different extraction temperatures of normal temperature and 70°C. Compared with different extraction times (10, 20, 30 and 60 minutes), the anthocyanins content can be increased to 0.50 mg/g as the highest in 30 minutes treatment. Extracting TTES No. 25 with different acidified methanol concentrations (50%, 75%, 100%). Extracting tea powder with 75% acidified methanol has the highest anthocyanins content (0.91 mg/g). However, TTES No.18 tea samples were extracted under different conditions, and the analytical values of anthocyanins were all lower than 0.02 mg/g. In summary, to analysis the anthocyanins content of purple shoot tea, using 75% acidified methanol solution (containing 0.1% formic acid) as the solvent, and perform ultrasonic extraction at room temperature for 30 minutes are the best extraction condition.

Key words: Purple shoot, TTES No. 25, Anthocyanins, pH-differential method

Study on the Quality, Liquor Color and Chemical Component Changes of Compressed Tea Made from Different Taiwan Tea Cultivars

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Summary

The purpose of this experiment was to understand the quality, liquor color and chemical components of compressed tea made from different Taiwan tea cultivars, so as to screen out suitable cultivars and provide a reference basis for compressed tea raw materials. The tested cultivars (lines) included TTES No. 12, Chin-Shin Oolong, Dah-Yeh Oolong, TTES No. 8 (large-leaf cultivar) and Yung-kang wild tea. Green tea and red oolong tea were made by hot air dried and sun dried respectively, and compressed into Tuocha for storage for 0 to 4 years. The results showed that the quality of green tea and red oolong tea among different cultivars changed slightly with the storage year. The best hot air dried green tea stored for 4 years was Yung-kang wild tea, and the best

sun-dried green tea was TTES No. 12, followed by Chin-Shin Oolong and Yung-kang wild tea. TTES No. 8 green tea was of poor quality. The quality of hot air dried red oolong tea was best in TTES No. 12 and Chin-Shin Oolong. Sun-dried red oolong tea was best in TTES No. 12, followed by Chin-Shin Oolong and Dah-Yeh Oolong, The red oolong tea quality of TTES No. 8 and Yung-kang wild tea was not good. No matter the hot air dried and sun dried green tea, The a, b and ΔE of tea liquor had not reached significant differences among TTES No. 12, Chin-Shin Oolong, Dah-Yeh Oolong and Yung-kang wild tea for storage 4 years, but the difference was higher than TTES No. 8. No matter the hot air dried and sun dried red oolong tea, the L, a, b and ΔE of tea liquor was significant differences in some cultivars for storage 4 years, with the lowest L value and a, b, ΔE values of TTES No. 8. The unfermented green tea made from large-leaf cultivar TTES No. 8 had the brightest tea liquor after storage, with the highest greenness and the lowest yellowness among different cultivars; the heavily fermented red oolong tea had the lowest brightness, the lowest greenness, and the highest yellowness. No matter the hot air dried and sun dried green tea or red oolong tea, the same results were shown; and the greenness of the tea liquor decreases with the storage year, and the yellowness increases. No matter the storage and dried, the level of green tea chemical component content among different cultivars had the same change, and the red oolong tea had similar results. The soluble solids, polyphenols, catechins and caffeine content of TTES No. 8 were significantly higher than other cultivars; the content of chlorophyll and carotenoids was lower than other cultivars. Due to the influence of the liquor color and chemical components of the tea leaves, the quality of compressed green tea and red oolong tea was not good.

Key words: Tea tree, Cultivar, Compressed tea, Quality

Differences in Chemical Compounds of Shortlisted Taiwan's Unique Teas from Tea Contest

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Summary

We collected the 9 types of Taiwan unique teas by selected grade from the tea contest, which are all made by small-leaf type tea cultivars, including one green tea, six partially fermented teas, and two black teas. We analyzed the chemical compounds of the tea by high performance liquid chromatography and liquid chromatography–mass spectrometry. The results show that the compounds' ion abundance highly correlated to their contents, which means that contents of compounds could be presumed by ion abundance. We also found that catechins are the main component of green tea, Wen-Shan Paochung tea, high mountain Oolong tea, Tong-Ding Oolong tea and Mu-Zha Tieh-Kuan-Yin tea. Furthermore, we presumed the abundance of catechins paired oxidative polymerization compounds depend on their monomers. Although, the theasinensins could be detected in all types of teas, the ion abundance in oriental beauty tea, red Oolong tea, small-leaf type black tea and honey flavor black tea were higher. Theaflavins could only be detected in oriental beauty tea, red Oolong tea, small-leaf type black tea and honey flavor black tea, which means that theaflavins are characteristic compounds of these teas. Gallic acid, quinic acid and flavonol glycosides generally existed in all types of teas with different abundance. In summary, tea chemical

compounds differ from the plucking standards and manufacturing process, so that the specific indicator ingredients and content can be used as a reference basis for Taiwan unique tea classification.

Key words: Liquid chromatography-mass spectrometry, Theasinensins, Theaflavins

Effect of Storage Packaging Materials and Temperatures on the Quality and Chemical Composition Content of Chrysanthemum

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Summary

Chrysanthemum is a local characteristic crop in Taiwan. The flowering period is concentrated from November to December. Dried flowers have large surface area so that are easy to absorb moisture and cause quality decline. The farmer's current storage method uses large transparent plastic packaging. The plastic bag covered with cloth to store at room temperature for sale. Due to the lack of relevant information on the quality of chrysanthemum under storage conditions, we plan a multiple factor test of packaging materials and storage temperatures. Discuss its influence on the quality of dried flowers of chrysanthemum after storage. The results show that the existing storage methods of farmers are most likely to cause the moisture content of dried flowers of chrysanthemum to increase, resulting in a decline in quality. After 24 months of storage, silverfish and browning will occur and the commodity value will be lost. When conditions permit, the best quality is stored in a transparent plastic bag and stored in 5°C or -20°C storage. However, due to the high cost of cold storage and freezing, the second choice is to store it in large aluminum tea bags after packaging. It can maintain a certain quality of dried flowers at room temperature for 24 months.

Key words: Chrysanthemum, Storage, Packaging material, Temperature

Can the Tea Sensory Evaluation be Different – from the Tea-qi of Tea-tasting Group to Look at This Issue

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Summary

The evaluation of the tea is archived as early as the Tang Dynasty in China while tea became a drink. Nowadays, when people get together and compare tea quality in various ways, it is actually a continuation of the ancient tea competition. Although in Taiwan the tea contest have held for over than 40 years, the tea sensory evaluation has developed a couple of items to make the judgment of tea quality, such as appearance, aroma, taste, colors of the tea liquors, infused leaves. Beyond the normal contest, many tea parties had held to make a comparison of teas. Recently, among these activities, one kind of tea evaluation is noticed that the tea flavor is felt through the body. The discourse of this kind of tasting is formed and it gradually has become a new trend in the tea social groups. The goal of

this kind of tasting is to judge the quality of the teas. In addition, this discourse is different from traditional evaluation because it uses somatosensory response to make the assessment. This kind trend of tea drinking starts from the Pu-erh tea drinking groups and has gradually expand to oolong teas. “Tea-qi” is a concept that seems to come from Chinese medicine, but actually comes from energy medicine. Its discourse is connected with the ecology of the tea plantations, the plantations’ management, etc. It is seemingly a vague term but sometimes it appears to be clear. Thus it might be a new judgment for tea selection. This paper intends to explore what kind of value connotations are reflected in the “Tea-qi” tasting, and what kind of inspiration it has for the present day Oolong tea tasting.

Key words: Tea-qi, Evaluation, Pu-erh tea, Tasting, Tea therapy