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# Update on organic tea in China

Organic tea is one of the leading crops in the organic agriculture sector in China. Great progress has been made in organic tea production and development in the last decade. By the end of 2011, the area under organic tea cultivation reached about 45 000 ha. Organic tea production was 35 000 tons with about 14 800 tons exported in 2011. The area, production and export of organic tea have increased by 33, 43 and 29 times, respectively, compared to 2000. The achievement in the organic tea development and production can be summarized as follows.

**Development of systematic approach for organic tea production**

Organic agriculture is a holistic approach that sustains health of soils, ecosystems and people. It relies on ecological processes, biodiversity and cycles adapted to local conditions. To maintain the healthy and sustainable development of organic tea, based on the principles and basic standard of organic agriculture, combining the indigenous and modern technologies, a series of organic tea regulations were developed and approved by the Ministry of Agriculture of China. These regulations include “Organic Tea” (NY 5196), “Technological Regulation for Organic Tea Production” (NY 5197), “Organic Tea Processing” (NY 5198) and “Environmental Conditions for Organic Tea Production Area” (NY 5199). These regulations are the basis for the organic tea production and certification.

**Integrated nutrient management in soils**

As a perennial and leaf harvested crop, tea needs more nitrogen compared with other crops with flowers or fruits as final products. Tea is a special crop since the soil becomes strongly acidified following planting of tea and soil pH generally continues to decrease with the increase of stand age, which strongly suppresses the soil microbial size and activities. Therefore, intercropping with leguminous crops, mulching and apply a high nitrogen content of organic fertilizers are necessary. A commercial biofertilizer with *Trichoderma harzianum* and other effective microbes and relatively high nitrogen content was developed and extensively used in organic tea fields. Table 1 shows the results of basic soil properties, tea yields and quality parameters after three consecutive years of use of the specialized tea biofertilizer.

An ecological agricultural system, “pig raising － biogas slurry － tea garden”, is recommended to organic tea producers. A field experiment showed that the biogas slurry produced by 45 pigs for tea garden of 1 ha had increased tea yields by 18 percent compared to a plot which did not receive any fertilizer control. Mulching with crop residues or weeds was also encouraged. The mulching materials should be free of pesticide residues and other pollutants.

**Table 1 – Effect of bio-fertilizer on soil basic properties and tea yield and quality components**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Treatment | Soil bulk density (g cm-3) | pH  (H2O) | Organic  Matter (%) | No. of microbes (million g-1) | Yield  (Kg/ha‑1) | Amino acids (%) | Poly- phenols  (%) | Caffeine  (%) |
| 1 | 1.40 | 4.06 | 1.65 b | 1.35c | 1980b | 2.15b | 18.99b | 3.02 |
| 2 | 1.25 | 4.35 | 2.16a | 12.50a | 2434a | 2.47ab | 21.89a | 3.20 |
| 3 | 1.25 | 4.42 | 2.18a | 18.35a | 2480a | 2.65a | 21.96a | 3.32 |
| 4 | 1.30 | 4.36 | 2.05ab | 6.50b | 2308ab | 2.43ab | 21.86a | 3.26 |

Treatment 1 – no fertilizer; 2 – tea specialist biofertilizer and rape seed cake 2 250 kg/ha-1, respectively; 3 – tea specialist biofertilizer 4 500 kg/ha-1; 4 – rape seed cake 4 500 kg/ha-1. Different letters denote significant difference (p<0.05) within a column.

**Integrated pest and disease management**

An integrated pest and disease management programme has been developed to control the key pests, including tea green leafhopper, tea geometrid (*Ectropis oblique*), caterpillar of *Euproctis pseudoconspersa* Strand and spiny white fly. The aim of this is the development and proper use of biopesticides, the key control points together with the agricultural, physical and mechanical measures and ecological balance recovery in tea garden and its surroundings. The biopesticides for tea geometrid, caterpillar of *Euproctis pseudoconspersa* Strand are two kinds of nuclear polyhedrosis virus, EoNPV and EpNPV, respectively. These NPVs together with *Bacillus thuringiensis* (Bt) are commercially produced in both powder and aqueous solution. EoNPV and EpNPV have been approved by the Ministry of Agriculture as pesticides and are commercially produced. The Table 2 shows the efficacies of EoNPV to control geometrids.

Table 2 – Effects of EoNPV on the control of geometrid in indoor and field conditions

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Treatment | Indoor 20℃ | Indoor 28℃ | | Field conditions | | |
| Larval mortality  (%) | Larval mortality  (%) | Until Pupal mortality  (%) | Larval mortality 3 days after application (%) | Larval mortality  (%) | Until Pupal mortality  (%) |
| EoNPV | 100 | 73.2 | 90.5 | 0 | 89.1 | 90.1 |
| EoNPV+Bt | 100 | 97.1 | 100 | 3.2 | 91.9 | 93.1 |
| Control | 0 | 0 | 0 | 0 | 0 | 0 |

Note: when the larvae were 2-3 instars the EoNPV applied at a rate of 750ml ha-1.

The tea green leafhopper and spiny white fly were controlled by the colour plate with info-chemical preparations (Figure 1). A high efficacy of entomogenous fungi was also developed to control tea green leafhopper, but is still under experiment. The high-pressure insecticidal lamp with solar energy or electricity was extensively used in organic tea fields. Some plants and minerals originated pesticides, such as matrine, fish cany ketone, pyrethrum and petroleum oils are commercially produced.



Figure 1  
Effect of info-chemical preparation with yellow plate on   
the control of spiny white fly

**Improvement of biodiversity in organic tea gardens**

The improvement of biodiversity or recovery of ecological balance in organic tea gardens is the key factor to pest and disease control and soil fertility management in long run. The main measures include intercropping especially with leguminous crops, such as soy bean, peanut and cloves. Shading trees planted along with the road and field side. Shading trees inside of tea gardens are not encouraged in the subtropical zone since it will reduce yield and quality of tea. Raising chickens and sheep in organic tea garden was recommended, which can not only control pests and improve soil fertility to some degree, but increase farmers’ profit through the chickens and sheep selling.

# Update on organic tea certification in China

The national organic certification standard “Organic Product” (GB/T 19630-2011) was revised and enforced in early 2011. It is replaced the old one GB/T 19630-2005. The new standard is much more strict compared with the old one. Strict management, severe punishment are key words of the new standard’s feature. The main changes are as follows:

* 1. The national standard is more consistent with international standards, such as those in the EU, Japan and the USA, and the basic standards of IFOAM and CAC. But it is much more strict than these international standards.
  2. No forbidden substances in organic food can be detected. Otherwise ,the organic certification would be revoked immediately, and the operator would not be allowed to apply for organic certification again within five years. Organic tea products should be tested at least once a year.
  3. The conversion time is at least three years for perennial crops, such as tea, and there are no reasons allowed for a shorter conversion period. The products in the first conversion year cannot be sold as conversion product.
  4. The quality of elements, such as air, soil and irrigation water (if applicable), should be tested once a year. The agricultural input not listed in the appendix of the standard should be evaluated and approved by CNCA.
  5. The certification procedure and organic label usage are much standardized and in detail. All the certification activities should inform CNCA beforehand. At least five percent of the operators should be inspected without notification in advance. Every product has its only label.
  6. For group certification, every smallholder should be inspected by external inspectors.
  7. If any operators severely violate the certification procedures, the certification would be revoked and could not be resumed for any reason.

Due to the strict management and the increase of certification cost, it is forecasted that the organic tea development in China will slow down. But consumers’ confidence in organic tea and other products will be enhanced. And it is beneficial to the sustainable development of the industry in long run.

# Current research for carbon credit and its certification

Intensive agriculture is responsible for large amounts of greenhouse gases and contributes 10-15% of the total global greenhouse gas emissions. Organic agriculture can be part of the solution. The carbon credit for organic agriculture is still striving, although no credit has yet been issued. However, early consideration for the carbon marketing is essential.

In the Tea Research Institute of the Chinese Academy of Agricultural Sciences several related projects are being implemented, including “tea soil respiration characteristics and its influencing mechanism” and “nitrate and N2O formation mechanism in tea soils and its affecting factors”. These projects are sponsored by the National Natural Science Foundation of China, while a project entitled, “Tea safety and key standardized technologies development in tea cultivation and their extension” is sponsored by the Ministry of Science and Technology of China. In terms of the carbon credit, both technical and administrative aspects are being studied.

On the technical aspect, we focus on two critical issues. One is carbon sequestration in organic tea soils and its quantification. The other is mitigation of greenhouse gases (mainly N2O and CO2) emission in organic tea fields compared to the conventional ones and its quantification. The quantification is important for possible carbon credit marketing.

On the administrative aspect, we are developing standards for possible low carbon certification. The standards will cover every aspects of organic tea production, which could increase carbon sequestration, greenhouse gases mitigation and energy use efficiency.

A systematic comparison between organic and conventional tea production is being conducted. The primary results show that soil pH, total organic carbon and nitrogen contents were higher in organic fields of all five comparative pairs. The organic carbon content in organic fields was 7.2 percent higher on average than its conventional ones. The carbon sequestrated in the organic soil is one percent more annually than its conventional counterpart. The biomass carbon, ninhydrin-nitrogen, and ratios of biomass carbon to total organic carbon, biomass ninhydrin-nitrogen to total nitrogen were significantly higher in organic fields in most of the comparison. The nitrous oxide (N2O) emission was lower in organic tea soils.

# Main challenges facing organic tea development

The challenges facing sustainable organic tea development are mainly from financial, technical and marketing aspects.

The decline of profit margin between organic and conventional tea, and the steadily increase of production costs – especially labour – are the major financial constraints. Compared with conventional tea, organic tea production needs more workers to undertake tasks such as composting and weeding, and wages have been steadily increasing. Labour shortage is another problem as it is becoming increasingly more difficult to hire temporary or seasonal workers. In addition, most tea producers are smallholders and produce famous premium tea. High certification costs and the management of smallholder associations for certification could deter them from being involved in organic tea production, especially with the enforcement of new regulations in China.

Although great progress has been made, soil fertility sustainability and pest and disease management continue to be the main technical problems. The source of organic fertilizers is limited, and the ratio of nitrogen to phosphorus and potassium are low compared with the requirements necessary to grow and develop tea plants. The kinds of biopesticides are not enough against various pests, and their quantities are insufficient due to various factors, including the impossibility of producing Nuclear Polyhedrosis Virus (NPV) on a large scale basis.

Consumers hesitate to believe that organic products are really produced in an organic way since some products on the market have been investigated and found to have been treated. Consumers are especially cautious when products are higher in price. Hopefully, the new organic standards and its very strict regulations could improve this situation. Organic tea consumption in the international market is increasing, but slowly.

# Further research needed for sustainable development of organic tea

To improve organic tea production and trading, combined efforts in organic tea producing countries are strongly needed in the following research areas:

* + 1. Selection of tea varieties with high nutrient use efficiency, especially low nitrogen requirement, or with high pest and disease resistance, especially to some key pests such as tea green leafhopper.
    2. Development of more organic or bio fertilizers with raw materials relative sufficient in local area and commercial fertilizers with nitrogen fixing, or phosphorus and potassium soluble microbes.
    3. Pest, disease and weed control technologies;
    4. Methodologies of distinguishing organic tea from conventional tea on whether chemical fertilizers were used.
    5. Technology and techniques to increase carbon sequestration and mitigate greenhouse gases emission for soil quality improvement and potential carbon trade opportunities.
    6. Both internal and external market information and marketing strategies.
    7. Socio-economic cost/benefit analysis on how organic tea generates employment, income and development in rural areas. This is especially important to obtain government support for its development