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Effects of soil enzymes and soil characteristics in different growing zones on growth and quality of Wuyi rock tea (*Camellia sinensis* L.)

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ABSTRACT

We analysed the soil characteristics, growth and quality indices of Wuyi rock tea (Rougui) in 3-growing areas (Yu, Guiyan, Qishan). The results showed that the available K and organic matter of tea soil in Qishan plantation were lower than soil fertility class I. The activity of most soil enzymes was Yu > Guiyan > Qishan. The growth indices of tea plant was Qishan > Guiyan ≈ Yu. The quality indices of fresh leaves were Yu > Guiyan > Qishan. Nitrogen was negatively correlated, whereas, K and organic matter were positively correlated with most soil enzymes. The growth indices of tea plant were positively correlated with N and catalase, but they were negatively correlated with K and organic matter and most soil enzymes. The quality indices of fresh leaves were negatively correlated with N and catalase, however, they were positively correlated with K and organic matter and most soil enzymes. There was negative co-relationship between the growth indices and the quality indices of fresh leaves. In brief, in Qishan soil on the one hand higher N facilitated the growth of Rougui tea leaves, but the deficiency of K and organic matter lowered the quality of Rougui tea leaves. The results suggested that to improve the quality of tea leaves in Qishan plantation, nitrogen content need to be reduced and the K and organic matter need to be increased in soil.

Keywords: *Camellia sinensis*, nitrogen, organic matter, potassium, soil characteristic, soil enzyme, tea growing areas, tea growth, tea quality.

INTRODUCTION

Wuyi rock tea is one of the best tea in China. "Yan Gu Hua Xiang" (rock appeal and flower fragrance) is its unique characteristic. The tea plant grows in the stony zone of Wuyi mountain, which imparts the unique taste of "Yan Yun" (rock flavour). Rock flavour is a distinct feature of Wuyi rock tea that differentiates it from other teas viz., green tea, black tea etc., and other oolong tea such as Tieguanyin and Taiwan oolong. However, tea production in the stony zone is far less than consumers demand. Hence, many hilly zones without the stony zone and even farmlands are used for tea growing. In Wuyi mountains, traditionally, the following 3-Types of Tea : Zhengyan, Banyan and Zhou cha (Table 2) are grown (3,5,22,31,38). Thus, the procurement price of fresh tea leaves in authentic rock zone is 30-50 times higher than in the continent zone.

Fertilizer application is an effective approach in the management of tea plantations to improve yield and quality (20,35,36,40,48). Zhang *et al.* (44) reported that potassium

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fertilizer mainly influenced the quality of Tieguanyin tea. Potassium fertilizer increases the content of amino acids and caffeine in tea leaves and also improves the aroma (24,27). Soil organic matter affects the plant's root growth and uptake of nitrogen, phosphorus and potassium and thereby affecting the formation of the secondary metabolites (47). The soil characteristics and natural environment are important factors for the excellent quality of Wuyi rock tea (2,3,23,33,43). Yao suggested that the best quality of Wuyi rock tea is from the tea plants grown in authentic rock zone, where, the soil has good permeability and is rich in organic matter, potassium and manganese (38). Sun *et al*. (31) referred that pH value, contents of potassium, zinc and exchangeable magnesium significantly differed between rock zone soil and continent zone soil. He suggested the application of organic manure and potassium fertilizer to improve the quality of Wuyi rock tea. Previous studies also reported that the application of organic manure and potassium fertilizer effectively improves the quality of Wuyi rock tea (5,39,42).

Due to the low purchase price of tea leaves in the continent zone of Wuyi county, tea farmers use more chemical fertilizer to increase tea yield for their economic benefits. Excessive use of chemical fertilizers causes environmental pollution and wastage of resources etc. To promote green development and quality of tea, Fujian provincial government promotes organic manures instead of chemical fertilizers in tea gardens. This study aimed to find the effects of soil fertility and enzymes on the growth and quality of tea leaves of Rougui (*Camellia sinensis* L), the popular tea cultivar grown in Wuyi rock area.

MATERIALS AND METHODS

Materials

Mount Wuyi falls in the subtropical zone with an annual mean temperature: 12℃ ~ 13℃, annual precipitation: > 2000 mm (highest in Fujian Province), Relative humidity: 85 % and the fog > 100 days. Three tea plantations (Yu, Guiyan and Qishan) in Wuyishan city, are the government approved (Table 1). Rougui (*Camellia sinensis* L.) cultured in

Table 1. Basic informations about 3-Tea plantation regions

Item	Yu	Guiyan	Qishan
Zone identified	Rock zone	Semi-rock zone	Continent zone
Geographical location	Latitude 27°38′42″-45″N, Longitude 117°56′38″-44″E	Latitude 27°36′26″-34″N, Longitude 117°57′52″-58′1″E	Latitude 27°42′51″-97″N, Longitude 117°59′58″-86″E
Year of planting	1980	1994	2009
Area*	8000 m^2	6667 m^2	26680 m^2
Honorary title	Tea germplasm resources reserve of Fujian Province (2009.10)	Tea germplasm resources reserve of Fujian Province (2010.11)	Demonstration base, agricultural science and technology park of Wuyishan City, Fujian Province (2014.1)
Unit providing protection	Agriculture department of Fujian Province	Agriculture department of Fujian Province	Science and technology Department, Fujian Province

*Areas under tea plantation

these plantations was chosen as test material. All samples were collected during the tea picking season from April to May.

Soil sampling and determination of soil indices

Soil samples were collected from the 3- tea plantations (Yu, Guiyan and Qishan) using equidistant sampling method. The planting areas were divided into 5-equal sections. Three tea plants in the centre of each section were considered as one sample, and three samples were collected in this way. Soil samples around the tea plant up to 15-25 cm radius and 25-35 cm depth were collected. The soil enzymes activities in the fresh soil were determined as per "Soil Enzyme and Research Method" (12).

(i). **Catalase activity**: It was determined based on potassium permanganate titration. Its activity was determined by the differences in the decomposition amount of hydrogen peroxide before and after enzymatic reaction.

(ii). **Urease activity**: It was evaluated by measuring the amount of ammonia generated after enzymatic reaction with urea as the substrate.

(iii). **The acid phosphatase activity**: It was determined by measuring the *p*-nitrophenol (PNP) released by phosphatase activity after soil incubation with buffered (pH 6.0 for acid phosphatase) sodium *p*-nitrophenyl phosphate (115 mM) solution.

(iv). **Polyphenol oxidase activity**: It was determined by oxidation of pyrogallol to galatin.

(v). **Protease activity**: It was determined by the reaction of protease with casein to form amino acids, and the reaction product with ninhydrin to form a coloured complex. According to the relationship between the colour of the solution and the content of amino acids, the amount of amino acids was obtained to indicate the protease activity.

(vi). **Sucrase activity**: It was determined by measuring glucose content after incubation for 24 h at 37 ºC with sucrose as a substrate.

All indices were determined in triplicate.

The soil samples were air dried, crushed to powder and sieved through a 60-mesh sieve, and 1 kg soil was taken as the test sample by the method of coning and quartering. The physico-chemical properties of the soil samples were determined as per "Soil Agrochemical Analysis Manual"(1). All indices were determined in triplicate. The soil fertility level was evaluated as per "Environmental Requirements for Tea-growing Areas (NY/T 853-2004)" (27), developed by Chinese Ministry of Agriculture.

Tea plants growth indices

The following growth parameters of the Rougui tea plant in these 3-plantations were measured.

(i). **Leaf number**: Twenty mature shoots were randomly selected in each plantation, and the number of leaves on each shoot were counted in three replicates.

(ii). **Leaf area**: Twenty leaves of mature shoots were randomly selected, and measured their length and width and calculated leaf area = length × width × 0.7.

(iii). **Bud density**: An iron frame (10 × 10 cm^2) area was placed randomly in the planting areas, and the bud numbers within the frame were counted and data was recorded from 6 places.

(iv). **Hundred bud weight**: The weight of 100 tea buds with 3 leaves picked up randomly from tea plants and weighed and was done in 3 replicates.

Tea leaves quality indices

The fresh leaves from the hundred bud weight tea plants were dried in hot air oven at 105 °C for 15 min, then dried at 80 °C for 48 h, then powdered and sieved through 60-mesh. The tea powder was kept refrigerated to determine the following tea quality indices (41) as per the National Standards of People's Republic of China.

(i). Polyphenols: GB/T 8313-2018 (9).

(ii). Free amino acids: GB/T 8314-2013 (10).

(iii). Caffeine: GB/T 8312-2013 (8).

(iv). Water extracts: GB/T 8305-2013 (7).

(v). Catechins: These were determined using high performance liquid chromatograph (HPLC) method (GB/T 8313-2018) (9) and instrument was Agilent 1260 (Agilent Technologies, USA) with C18 column (250 mm × 4.6 mm, 5 µm).

(vi). Theanine: It was determined using the HPLC method (GB/T 23193-2017) (6) and the instrument was Sykam S-433D automatic amino acid analyzer with C18 column (250 mm × 4.6 mm, 5 µm).

(vii). Soluble sugar: It was determined as per "Principles and Techniques of Plant Physiological and Biochemical Experiments" (17). These were determined in three replicates for all tea samples.

Data analysis

All experimental data were presented as mean ± standard error (SE). They were analysed using a one-way analysis of variance (ANOVA) and followed by the least significant difference (LSD). Excel software 2010 was used to conduct statistics and variance analysis, and DPS 7.05 data processing system was used to conduct significance and correlation analysis.

RESULTS AND DISCUSSIONS

Soil characteristics of tea plantations

Yu, Guiyan and Qishan tea plantation were located in Authentic rock zone, Semi-rock zone, Continental zone, respectively (Table 2).

Table 2. Main 3- tea types, their quality and growing areas in Wuyi mountains

#	Tea Type	Tea quality	Growing areas
(i)	Zhengyan Cha (Authentic rock tea)	Top	Stony zone
(ii)	Banyan Cha (Semi-rock tea)	Medium	Hilly zone near stony zone
(iii)	Zhou Cha (Continental tea)	Low	Away from stony zone

The soil physico-chemical properties of the 3-Rougui tea plantations showed that the soil pH values were suitable for tea growth and most properties reached the class I standard of soil fertility (Table 3). The available K in Qishan and the organic matter of

Guiyan and Qishan were in the class II soil fertility standard. Moreover, available K, and organic matter in Qishan were 82 % and 70 %, respectively, of class I standard of soil fertility.

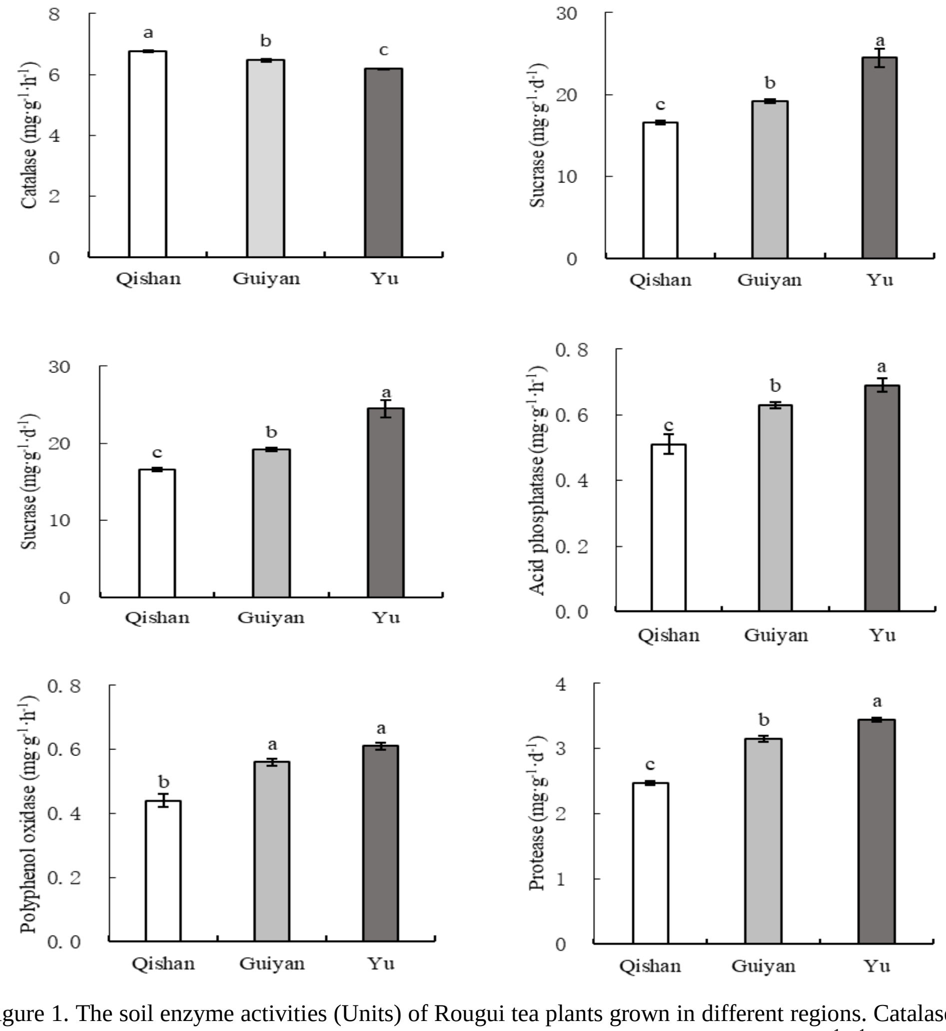

Figure 1. The soil enzyme activities (Units) of Rougui tea plants grown in different regions. Catalase activity determination was based on potassium permanganate titration (mg $g^{-1}h^{-1}$); Urease activity as amount of ammonia generated (mg $g^{-1}d^{-1}$) from urea; the activity of acid phosphatase was determined by measuring the *p*-nitrophenol (PNP) released from sodium *p*-nitrophenyl phosphate (115 mM) solution (mg $g^{-1}h^{-1}$); activity of polyphenol oxidase was determined by oxidation of pyrogallol to gelatin (mg $g^{-1}h^{-1}$). Protease activity was determined by release of amino acids from casein as ninhydrin color complex (mg $g^{-1}d^{-1}$); Sucrase activity determined as glucose (mg $g^{-1}d^{-1}$) content after incubation with sucrose as a substrate. The lowercases represent a significant difference at $P < 0.05$ level.

The available N, available K and organic matter in Qishan soil were 1.39, 0.82 and 0.70 times, respectively, compared to class I standard of soil fertility, however, these were 1.29, 1.08 and 1.11 times, respectively in Yu soil (Table 3). These results indicated that with higher N, lower K and lower organic matter in Qishan the soil was poorer, while the soil with higher K and higher organic matter in Yu was better in the recycling, transformation and utilization of soil nutrients.

The results of comparative soil enzyme activities of Rougui tea plant from 3-plantations were significant in following order:

(i). Catalase: Qishan > Guiyan > Yu,

(ii). Sucrase, urease, acid phosphatase and protease were Yu > Guiyan > Qishan, and

(iii). Polyphenol oxidase was Yu ≈ Guiyan > Qishan (Figure 1).

Correlation analysis between the soil enzyme activity and the soil indices showed that correlation between total N and available N were positive and significant ($P < 0.05$ or $P < 0.01$) and negative correlation with urease, acid phosphatase, polyphenol oxidase and protease (Table 4). Total K and available K were significant ($P < 0.05$) and positively correlated with sucrase, acid phosphatase, polyphenol oxidase and protease. Organic matter was significant ($P < 0.01$) and positively correlated with urease, acid phosphatase, polyphenol oxidase and protease, whereas significant ($P < 0.05$) and negatively correlated with catalase. Higher N was detrimental to soil enzyme activity, while, higher K and higher organic matter were beneficial to soil enzyme activity.

Soil is main medium for plant growth and soil nutrition is closely related to soil enzymes activity (12). Soil enzymes play an important role in the recycling, transformation and utilization of soil nutrients. The pH, N and organic matter are the main factors affecting the enzyme activity of mountain soil (18,30,34,37,45). Li *et al*. showed that soil catalase activity was negatively correlated with N, organic matter and available K (20). Zhao *et al*. showed that organic matter had the greatest influence on urease and catalase activity, and the most important factors affecting the invertase activity were: soil available N, K and organic matter (46). Li *et al*. showed that phosphatase and sucrase were significantly positively correlated with available K in the 20-40 cm soil layer (16). He *et al*. found that in rock slope, total K and available K had positive effects on soil enzyme activity (14). The major components contributing significantly to the enzyme and microbial biomass of tea soil were pH, total P, total N, available P and available K (19). In the study of organic fertilizer on soil fertility and enzyme activity in arid areas, Ma *et al*. found that soil phosphatase, urease and sucrase activities were significantly positively correlated with organic matter, total N and available NPK (26). In this paper, most soil enzyme activities were negatively correlated to total N and available N, whereas, were positively correlated to available K and organic matter (Table 4).

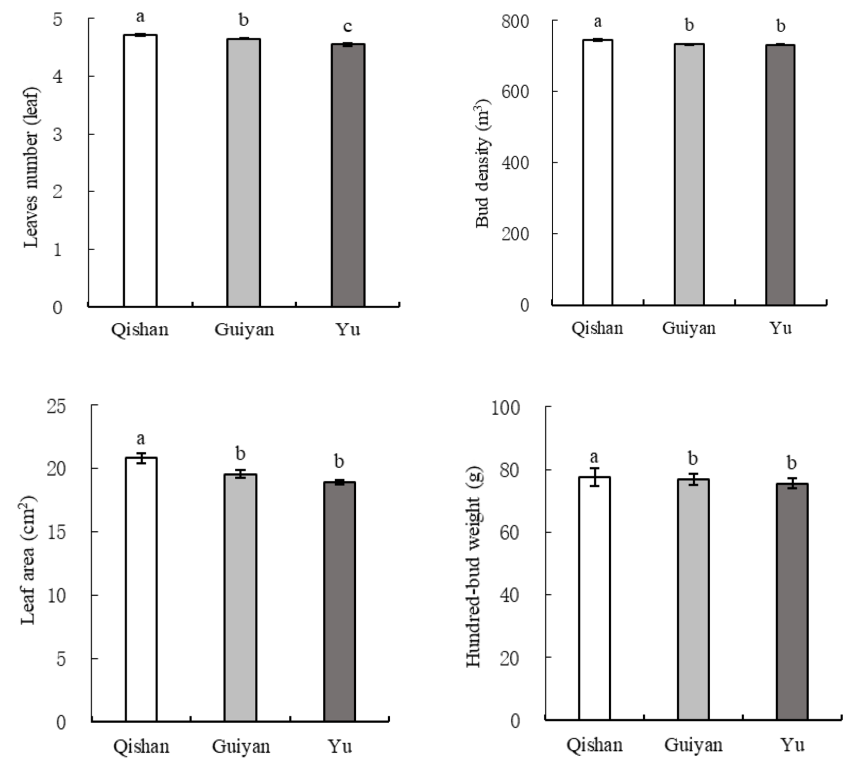

Figure 2. The growth index of Rougui tea leaves. The lowercases represent a significant difference at *P* < 0.05 level.

Table 3. Soil physico-chemical properties of Rougui tea plant

Soil fertility Index	**Qishan**	**Guiyan**	**Yu**
pH value	4.52±0.01a	4.52±0.01a	4.22±0.02b
Total N ($g·kg^{-1}$)	1.42±0.02a (I)*	1.17±0.02b (I)	1.15±0.01b (I)
Total P ($g·kg^{-1}$)	0.99±0.03a (I)	0.85±0.02b (I)	0.89±0.02b (I)
Total K ($g·kg^{-1}$)	10.22±0.14b (I)	10.57±0.11b (I)	12.21±0.20a (I)
Available N ($mg·kg^{-1}$)	138.70±2.57a (I)	130.24±0.78b (I)	128.71±1.68b (I)
Available P ($mg·kg^{-1}$)	13.13±0.21a (I)	13.46±0.09a (I)	12.76±0.08b (I)
Available K ($mg·kg^{-1}$)	98.13±1.16b (II)	126.64±2.46a (I)	129.85±1.56a (I)
Organic matter ($g·kg^{-1}$)	10.54±0.39c (II)	14.56±0.55b (II)	16.68±0.23a (I)

Note: The lowercases represent a significant difference at P <0.05 level. * The soil fertility standard in parentheses was evaluated referring to "Environmental requirement for growing area of tea (NY/T 853-2004), Chinese Ministry of Agriculture”. Soil fertility in grade I was good, grade II was fair, and grade III was poor. Soil with Grade I and II were suitable for the growth of tea plants.

Table 4. Correlation coefficient (r) between the soil physio-chemical properties and the soil enzymes activity

Correlation coefficient (r)	pH	Total N	Total P	Total K	Available N	Available P	Available K	Organic matter
Catalase	0.87	0.90	0.69	-0.94	0.95	0.53	-0.91	-0.98*
Sucrase	-0.95	-0.80	-0.54	0.99*	-0.87	-0.68	0.81	0.93
Urease	-0.80	-0.94	-0.77	0.89	-0.98*	-0.43	0.95	1.00**
Acid phosphatase	-0.76	-0.96*	-0.82	0.85	-0.99**	-0.36	0.97*	1.00**
Polyphenol oxidase	-0.73	-0.98*	-0.84	0.83	-1.00**	-0.32	0.98*	1.00**
Protease	-0.73	-0.97*	-0.84	0.83	-1.00**	-0.32	0.98*	1.00**

Note: * and ** represent a significant level at $P < 0.05$ and at $P < 0.01$, respectively.

Tea plant growth indices

The growth indices of Rougui tea plants showed that of the 3-plantations, the number of leaves differed and were in order: Qishan > Guiyan > Yu. The differences in the bud density, leaf area and hundred-bud weight were also significant: Qishan > Guiyan ≈ Yu (Fig. 2). In general, the growth of Rougui tea plant in Qishan was better

Correlation analysis between the soil indices and the growth indices of Rougui tea plant showed that total N, available N and catalase were significant ($P < 0.05$ or $P < 0.01$) and positively correlated with most growth indices (Table 5). Whereas total K, available K, organic matter, and 5 of the 6 soil enzymes were significant ($P < 0.05$ or $P < 0.01$) and were negatively correlated with the growth indices.

Rougui tea leaves quality indices

The results of the quality index in Rougui tea leaves showed that in 3-plantations, the contents of tea polyphenols, soluble sugar and water extracts were: Yu > Guiyan > Qishan (Fig. 3 and Fig. 4). The contents of free amino acids and theanine were Guiyan > Yu > Qishan. The content of catechins was Yu ≈ Guiyan > Qishan and the content of caffeine was Qishan > Yu ≈ Guiyan. Higher content of tea polyphenols, free amino acids, soluble sugar, aqueous extracts, catechin and theanine in Yu plantation were 1.54, 1.67, 1.14, 1.20, 1.55, and 1.84 times, respectively than in Qishan. In general, the quality of Rougui tea leaves was in order: Yu > Guiyan > Qishan.

In China, tea quality has regional characteristics, which have been confirmed in studies on Longjing green tea and Pu'er tea (25,27,49). Our results showed that the quality index of Rougui tea leaves in Yu plantation was significantly better than in Qishan plantation (Fig. 3 and 4). The results are consistent with the local traditional knowledge and previous studies that the quality of Wuyi rock tea in authentic rock zones is much better than in the continent zones (3,5,21,31,38,40).

Correlation analysis between the soil index and the quality indices of Rougui tea leaves showed that total N, total P and available N were significant ($P < 0.05$ or $P < 0.01$) and negatively correlated with most of the quality indices (except caffeine), and available K and organic matter were significant ($P < 0.05$ or $P < 0.01$) and positively correlated with most of the quality indices (except caffeine) (Table 6). All soil enzymes, except catalase were positively correlated with most of the quality indices except caffeine.

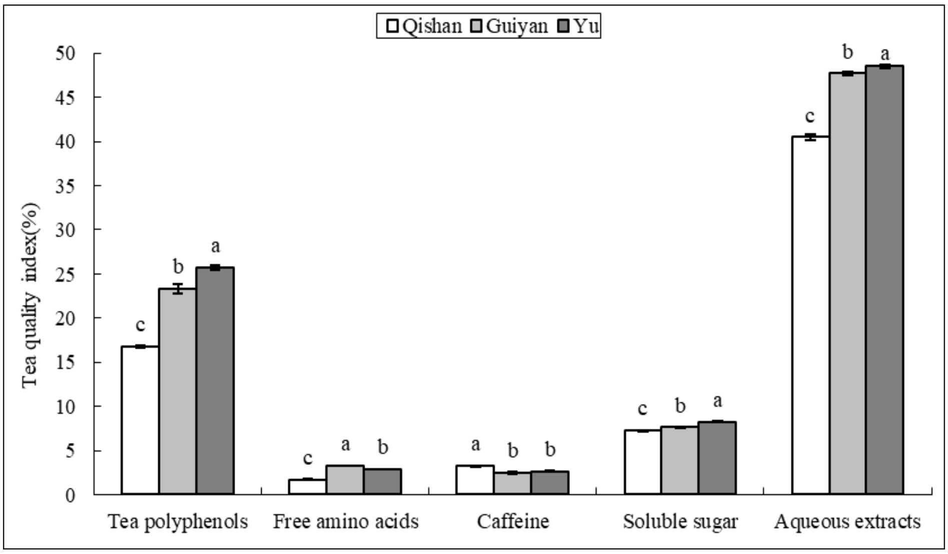

Figure 3. The quality index (%) of Rougui tea leaves. The lower cases represent a significant difference at $P < 0.05$ level.

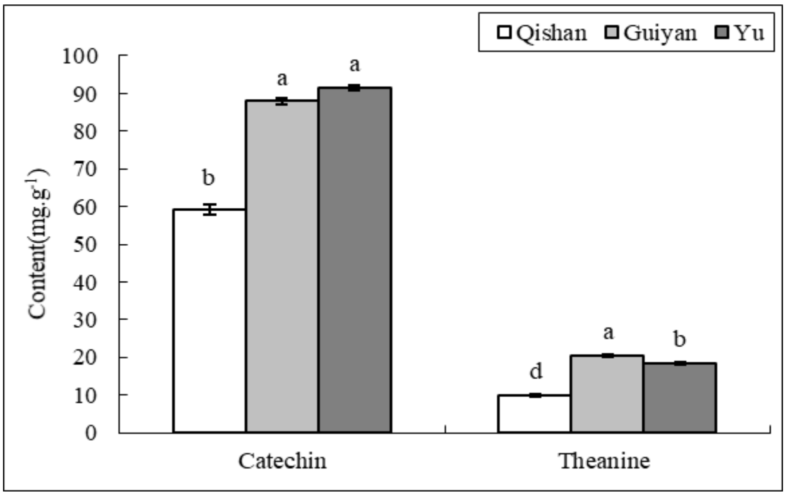

Figure 4. The contents (mg g^{-1}) of catechin and theanine in Rougui tea leaves. The lower cases represent a significant difference at $P < 0.05$ level.

Correlation analysis between the growth indices and the quality indices of Rougui tea leaves showed that most of the quality index (except caffeine) were negatively correlated with the growth indices (Table 7).

Table 5. Correlation coefficient (r) between the soil indices and the growth indices of Rougui tea plant

Correlation coefficient (r)	Soil Indices								Enzymes					
	pH	Total N	Total P	Total K	Available N	Available P	Available K	Organic matter	Catalase	Sucrase	Urease	Acid phosphatase	Polyphenol oxidase	Protease
Leaf number	0.91	0.85	0.62	-0.97*	0.89	0.61	-0.86	-0.96*	0.99**	-1.00**	-0.98*	-0.96*	-0.94	-0.95
Bud density	0.54	1.00**	0.95	-0.67	1.00**	0.08	-1.00**	-0.96*	0.89	-0.79	-0.94	-0.96*	-0.97*	-0.97*
Leaf area	0.77	0.96*	0.81	-0.86	0.98*	0.37	-0.97*	-1.00**	0.98*	-0.93	-1.00**	-1.00**	-1.00**	-1.00**
Hundred bud weight	0.95	0.79	0.54	-0.99*	0.84	0.69	-0.81	-0.93	0.98*	-1.00**	-0.95*	-0.93	-0.91	-0.91

Note: * and ** represent a significant level at $P < 0.05$ and at $P < 0.01$, respectively.

Table 6. Correlation coefficient (r) between the soil indices and the quality indices of Rougui tea leaves

Correlation coefficient (r)	Soil Indices								Enzymes					
	pH	Total N	Total P	Total K	Available N	Available P	Available K	Organic matter	Catalase	Sucrase	Urease	Acid phosphatase	Polyphenol oxidase	Protease
Tea polyphenol	-0.71	-0.98*	-0.85	0.81	-0.99**	-0.29	0.98*	1.00**	-0.97*	0.90	0.99*	1.00**	1.00**	1.00**
Free amino acid	-0.28	-0.95*	-1.00**	0.43	-0.93	0.21	0.94	0.83	-0.72	0.57	0.79	0.84	0.86	0.86
Caffeine	0.30	0.96*	1.00**	-0.45	0.93	-0.19	-0.95*	-0.84	0.73	-0.59	-0.81	-0.85	-0.87	-0.87
Soluble sugar	-0.94	-0.81	-0.57	0.98*	-0.86	-0.66	0.83	0.94	-0.99*	1.00**	0.96*	0.94	0.92	0.93
Aqueous extracts	-0.58	-1.00**	-0.93	0.70	-1.00**	-0.12	1.00**	0.97*	-0.91	0.81	0.95	0.97*	0.98*	0.98*
Catechin	-0.59	-1.00**	-0.93	0.71	-1.00**	-0.13	1.00**	0.97*	-0.91	0.82	0.95*	0.97*	0.98*	0.98*
Theanine	-0.31	-0.96*	-1.00**	0.46	-0.94	0.17	0.96*	0.85	-0.74	0.60	0.81	0.86	0.88	0.88

Note: * and ** represent a significant level at $P < 0.05$ and at $P < 0.01$, respectively.

Table 7. Correlation coefficient (r) between the growth index and the quality index of Rougui tea leaves

Correlation coefficient (r)	Leaf number	Bud density	Leaf area	Hundred bud weight
Tea polyphenol	-0.94	-0.98*	-1.00**	-0.90
Free amino acid	-0.65	-0.96*	-0.83	-0.57
Caffeine	0.66	0.96*	0.84	0.58
Soluble sugar	-1.00**	-0.80	-0.94	-1.00**
Aqueous extracts	-0.86	-1.00**	-0.97*	-0.81
Catechin	-0.87	-1.00**	-0.97*	-0.81
Theanine	-0.67	-0.97*	-0.85	-0.60

Note: * and ** represent a significant level at $P < 0.05$ and at $P < 0.01$, respectively.

Higher N in soil was positively correlated to the growth indices of tea leaves, but was negatively correlated to the quality indices of tea leaves (Table 5 and Table 6). This indicated that higher N increased the tea yield but decreased the tea quality. Most of the soil enzymes activity (except catalase) was positively correlated to the quality indices of tea leaves and negatively correlated to the growth indices of tea leaves (Table 5 and Table 6). These results suggested that higher K and higher organic matter content were positively correlated with soil enzymes and tea quality. The growth indices and the quality indices, except caffeine of tea leaves showed negative correlation (Table 7). Tea quality is mainly determined by secondary metabolites (tea polyphenols, catechins, amino acids, caffeine, etc.) in tea leaves (11,32). It is apparent that when the energy and primary metabolites are constant, these are mostly used for the growth of tea plant and less for the synthesis of secondary metabolites. Our results suggested that the higher yield and lower quality of tea leaves in Qishan resulted from its higher N and lower K and organic matter in soils.

Soil organic matter can affect the root growth and NPK uptake by tea plants and thus affect the formation of secondary metabolites (47). The improvement of soil organic matter and K increases the soil microbial and enzyme activity, thereby, improving the yield and quality (13). Zhang believed that K is the main fertilizer factor influencing the quality of tea plants (44). Potassium fertilizer increases the content of amino acid and caffeine in tea (24). Dong *et al*. pointed out that K fertilizer significantly improved the quality of tea (12). Most studies also showed that improving the organic matter of Rougui tea soil and application of K fertilizer effectively improves the quality of Wuyi rock tea (5,39,42). It was evident from these studies that good quality of Rougui tea leaves in Yu was attributable to higher K and higher organic matter in soils.

CONCLUSIONS

In Qishan soil, excessive nitrogen facilitated the growth of Rougui tea leaves, but the deficiency of K and organic matter contributed to low quality of Rougui tea leaves. To improve the quality of tea leaves in Rougui tea plantations located in the continent zone, such as Qishan tea plantation of Wuyishan county, we suggested to reduce the nitrogen fertilization, increase potassium and organic matter content in Qishan plantation soils.

Improvement in the tea quality in the continental zone will benefit the tea farmers and the less use of chemical fertilizer will protect the environment of Wuyi mountain.

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CONFLICT OF INTEREST

The authors announce that they have no conflict of interest.

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