ANALYSIS OF TOTAL NITROGEN (N), DIPHOSPHATE PENTA OXIDE (P₂O₅) TOTAL, KALI OXIDE(K₂O) TOTAL IN THE SOIL AFFECTS THE GROWTH AND DEVELOPMENT OF TEA IN TAN CUONG COMMUNE OF THAI NGUYEN PROVINCE IN NORTHERN REGION, VIETNAM

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ARTICLE INFO	ABSTRACT
Received: 03/11/2021	Tea is one of the most popular beverages in the world because of its taste, aroma, and health effects. Vietnam is ranked as the seventh largest global tea producer in 2016 with 240,000 tons of production quantity as well as 96.825 million dollars grossed from 73,571 ton exports (FAOSTAT 2018). This study investigated general physicochemical properties of tea garden soils in Tan Cuong commune, Thai Nguyen city, Vietnam. Three locations selected as study sites. Soil samples were collected from the surface (0–10 cm) and subsurface (20–30 cm). Determining and analyzing the content of nitrogen (N), phosphorus (P), potassium (K) in the soil affects the growth and development of tea plants in Tan Cuong commune - Thai Nguyen city in each period. Very important and is the premise for tea plants to give high yield and good quality. The results of this study evaluate and analyze the content of Nitrogen (N), Phosphorus (P), Potassium (K) of some soil samples suitable for tea plants to grow and develop well in Tan Cuong commune.
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PHÂN TÍCH HÀM LƯỢNG NITƠ (N) TỔNG SỐ, DIPHOSPHO PENTA OXIT (P₂O₅) TỔNG SỐ, KALI OXIT (K₂O) TRONG ĐẤT ẢNH HƯỞNG ĐẾN SINH TRƯỞNG VÀ PHÁT TRIỂN CỦA CÂY CHÈ TẠI XÃ TÂN CƯƠNG TỈNH THÁI NGUYÊN MIỀN BẮC VIỆT NAM

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THÔNG TIN BÀI BÁO	TÓM TẮT
Ngày nhận bài: 03/11/2021	Trà là một trong những đồ uống được ưa chuộng nhất trên thế giới vì mùi vị, hương thơm và tác dụng đối với sức khỏe. Việt Nam được xếp hạng là nước sản xuất chè lớn thứ bảy toàn cầu vào năm 2016 với sản lượng 240.000 tấn cũng như 96,825 triệu đô la thu được từ 73.571 tấn xuất khẩu (FAOSTAT 2018). Nghiên cứu này đã khảo sát các đặc tính lý hóa chung của đất vườn chè tại xã Tân Cương, Thái Nguyên, Việt Nam. Ba địa điểm được chọn làm địa điểm nghiên cứu. Các mẫu đất được thu thập từ bề mặt (0–10 cm) và dưới bề mặt (20–30 cm), xác định và phân tích hàm lượng đạm (N), lân (P), kali (K) trong đất ảnh hưởng đến sinh trưởng và phát triển của cây chè tại xã Tân Cương - Thái Nguyên trong từng thời kỳ. Rất quan trọng và là tiền đề để cây chè cho năng suất cao, chất lượng tốt. Kết quả nghiên cứu này đã đánh giá và phân tích hàm lượng Đạm (N), Phốt pho (P), Kali (K) của một số mẫu đất phù hợp cho cây chè sinh trưởng và phát triển tốt tại xã Tân Cương.
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1. Introduction

In Vietnam, tea production is considered as an important national agro-industrial sector, leading to job creation, poverty alleviation, and foreign exchange earnings [1]-[3]. Thai Nguyen province, located on the north side of Hanoi, is regarded as the core area for tea production praised with top quality in the country. The effects of tea plant cultivation (*Camellia sinensis*) on soil properties and soil-plant nutrient dynamics have been extensively studied in major tea-producing countries such as Japan, China, India, and Kenya: excessive amounts of ammonium fertilizers are applied to tea garden soils because it is believed that a higher N application can improve tea growth and its leaf quality [4], [5]. In Vietnam, soil science studies on tea cultivation have been very limited so far: in Thai Nguyen province, Dang (2005, 2007) carried out the detailed investigation on nutrient balances between soils (Kanhaplustults derived from shale, pH 3.9–4.4, clay >40%) and tea plants in order to establish soil quality index [6], [7]. Thai Nguyen, Vietnam, is a city in the midland and mountainous areas of the North, which is endowed by nature with a system of land and climate conditions that are quite suitable for the development of tea plants. Compared to other districts in the province, the city has a fairly large tea area, which is popular mainly in the western communes, with the key areas being communes: Tan Cuong, Phuc Triu, Phuc Xuan, and Thinh Duc. Currently, tea has become one of the key crops contributing to economic restructuring and improving people's lives. The application of fertilizers in an excessive amount creates an excess of some substances in the soil, water, air or due to the process of metabolism and movement of fertilizers in the soil, leading to the status of some substances such as heavy metals, nitrates, microorganisms. Harmful organisms... are introduced to increase the level of soil pollution, surface water, groundwater. The assessment of people and analysis of NPK content in the soil helps people supplement nutrients for tea plants to grow and develop well, protect soil resources, protect health and protect the environment.

2. Research methods

Tan Cuong is a rural commune in Thai Nguyen province (Fig.1). The climate is tropical monsoon characterized by the hot and moist season from April to September and the cool and dry season from October to March. According to the meteorological record during the last decade of Thai Nguyen Meteorology Station, the annual average temperature is 23.6°C with the maximum of 29.0°C in July and the minimum of 15.8°C in January. The average annual precipitation is 1767 mm, 84% of which falls from April to September. This study evaluates and analyzes the content of soil samples on the growth, quality, and economic efficiency of tea plants in Tan Cuong commune, Thai Nguyen city.

Figure 1. Study areas, site in Tan Cuong

- Soil samples: Three locations selected as study sites. Soil samples were collected from the surface (0–10 cm) and subsurface (20–30 cm).

Soil samples at the depth of 0–10 cm (surface) and 20–30 cm (subsurface) were collected from two or three points between hedges of tea plants.

Sample Coordinates in Table 1.

Table 1. *Results of soil mechanical composition analysis*

Sample	X	Y
1	21°32'27.1"	105°46'36.8"
2	21°32'26.4"	105°46'36.3"
3	21°32'26.1"	105°46'37.4"

- Samples were preserved according to TCVN and brought to the laboratory of the Institute of Reproductive Science - Thai Nguyen University of Agriculture and Forestry for analysis.

Table 2. *Comparative testing criteria and methods*

Number	Analytical indicators	Comparative standards
1	pH _{KCl}	TCVN 5979:2007
2	Σ N ₂	TCVN 8557: 2010
3	Σ P ₂ O ₅	TCVN 8563:2010
4	Σ K ₂ O	TCVN 8562: 2010
5	humus	TCVN 9294 : 2012

- Secondary data collection method was used to collect all relevant information and documents. Numerical analysis methods and software were applied to build quality analysis models. Data processing and analysis methods were used to analyze the parameters and technical criteria of the construction soil by software Excel 2010.

- Experimental method of measuring size on tea plants, at each sampling location, plant and take tea samples on that soil sample to monitor the growth and development of LPD 1 tea variety.

- Another method: Efficiency and analysis of each sample location. Method of determination was applied to determine the age of tea buds. At each time, 50g of the sample were weighted to break the number of buds of the sample. For stalks bent backward from the stalk to the top of the bud, for the leaves that are broken from the petiole to the tip of the leaf, the wood fiber part is the part that is present in the amount of P1, the young part weights P2.

(P1 +P2=50g)

Ratio (%) cake buds = P1:50x100

Ratio (%) young buds = P2:50x100.

- Based on the ratio of calendula to evaluate the quality of buds according to each recipe.

The standard of fresh bud tea is specified (according to TCVN1053-2011 as follows: The ratio of ingredients the mean lobe is the average of the values at 3 replicates, respectively. Monitoring the quality indicators of tea varieties. The quality of raw tea was analyzed for biochemical parameters: Tannin, soluble matter, total sugar, amino acids at the Northern Mountainous Agro-Forestry Science and Technology Institute. Monitor soil analysis criteria: take soil samples at 2 layers depth: 0-20 cm, 20-30 cm. Analyze the results according to TCVN1053-2011.

3. Results and discussion

3.1. Results of soil mechanical composition analysis

Results of soil mechanical composition analysis in Table 3.

Table 3. *Results of soil mechanical composition analysis*

Sample	Σ Nitrogen (N ₂) (%)	Σ P ₂ O ₅ (%)	Σ K ₂ O (%)	Average
S1	0.06	0.01	0.128	0.07
S2	0.09	0.03	0.22	0.11
S3	0.09	0.02	0.32	0.14

Evaluation of soil properties through data tables and graphs shows that the composition of total nitrogen, total P_2O_5 and total K_2O in sample 3 is highest.

Figure 3. Comparison chart of total Nitrogen (N), diphosphate penta oxide (P_2O_5), kali oxide (K_2O) values in the study area

The above chart shows the analysis results at 3 sampling locations, then these soil samples were preserved and brought to the experimental area for experimental planting with LDP1 tea samples and then compared with the control samples.

3.2. Results of the Growth and quality of LDP1 tea on soil samples

3.2.1. Results of the Growth and the experimental Leaf Tea index at locations of soil samples

Monitoring the growth of experimental LDP1 tea plants, we obtained the results in the table below. At the stage of business (1-2 years old) tea tree yield is not high, due to the growing canopy frame, appropriate fertilizing method for tea at this stage is extremely important, creating favorable Climatic conditions and care for the tea plants on the soil samples were similar. The results of growth and development of tea plants during the experiment on soil samples are shown in Table 4.

Table 4. Growth of tea stems at locations of soil samples

Tea on Soil sampling location	Diameter (cm)		Heigh (cm)		Wide canopy (cm)		Canopy thickness (cm)	
	After experime nt	% compar ed with the control	After experime nt	% compar ed with the control	After experiment (Results of measuring tea buds)	% compar ed with the control	After experim ent	% compar ed with the control
(T0) (Tea control)	2.57	100	80.58	100	96.46	100	30.27	100
(T1)Tea 1	2.63	102.3	84.38	104.7	97.56	101.14	31.25	103.2
(T2) Tea 2	2.80	108.9	87.73	108.9	100.5	104.2	32.16	106.3
(T3) Tea 3	2.48	96.5	76.51	90.7	94.13	97.6	28.86	95.3
P	>0.05		>0.05		>0.05		<0.05	
LSD _{0,05}	0.31		8.74		11.08		1.76	
CV%	6.8		6.1		6.6		3.3	

- The parameters of trunk diameter, tree height, and canopy width in formulas T1, T2, and T3 were all higher than those of the control formula. The difference was not significant at the 95% confidence level.

- Regarding canopy thickness with 3 experimental and one Control formulas on tea varieties, all showed that sample Tea 2 had the highest canopy thickness of 32.16 cm, an increase of 106.3% compared to the control, the lowest was Tea1 with 31.25 cm but still 100.09% higher than certain controls at 95% confidence level. Thus, comparing the formulas of tea varieties, we can see that Tea 3 compared to the control, tea 3 was lower than the control because the soil had not been cared for many years. It proves that the composition of soil substances in this area has had a positive impact on the growth indicators. This means that the ability of tea plants to grow many branches and give many buds is a prerequisite for high yields.

Table 5. *Effect of soil properties on growth and development of tea buds*

<i>Unit: cm</i>					
Tea on Soil sampling	Tea shrimp	Leaf 1	Leaf 2	Leaf 3	Petiole
Tea 1	7.46	8.31	20.82	34.4	29.01
Tea 2	7.41	8.27	21.68	34.39	28.25
Tea 3	7.83	8.85	22.05	32.43	28.84
T0 (Tea control)	6.78	7.92	21.35	33.07	30.88

(Analysis results in 2020)

- LDP1-like tea buds have 3 leaves and stalks that account for the highest percentage, these two components are equivalent. This proves that to have favorable materials for processing, only young buds should be picked (shrimp +2 leaves). In the experimental treatments, Tea 3 of the tea variety gave the highest ratio of shrimp + leaf 1 + leaf 2 at 38.73%, which mean that ratio 3 and stem is higher than other treatments. Therefore, fertilizing according to Tea 3 will give the quality of raw materials for processing dry tea.

- The influence of soil mechanical composition (Nitrogen content) on the growth dynamics of tea bud length in the experiment is shown in Figure 3. The growth of tea bud length is an important factor during the process of growth and development of tea plants. This is a decisive factor to the time of picking and the time of picking. It is also related to the cultivation techniques for the good growth of tea plants [5].

Figure 4. *Effect of nitrogen content in soil on growth and growth behavior of LDP1 tea buds (cm)*

On that basis, the authors monitored the growth of tea buds of the LDP1 tea variety. The results are shown in Table 4 and shown in Figure 4 show that the growth in bud length of LDP1 variety has changed over time as follows: in the first 15 days there was no significant difference between treatments, Tea 2 (2.65 cm) had a higher growth rate than the control formula, the lowest was the control treatment (1.69 cm). From day 30 onwards, the formulas had fairly rapid growth, Tea 1 had the highest superiority. reached 6.45 cm higher than control 1.03 cm, control

Tea 0 was still the lowest formula (5.42 cm). The above results show that recipe 3 is the formula with the highest growth in lobe length.

3.2.2. Soil nutrient composition affects tea quality

To evaluate the quality of tea buds, I analyzed the biochemical composition of the tea buds, the results were obtained in Table 4 and Table 5.

Table 5. Effect of soil N; P_2O_5 ; K_2O content on growth dynamics of tea bud length

Unit: cm

Tea on Soil sampling	5	10	15	20	25	30
Tea 1	0.89	1.32	1.88	2.93	4.34	5.76
Tea 2	1.11	1.53	2.17	3.18	4.63	6.03
Tea 3	1.23	1.68	2.65	3.74	5.14	6.45
(control)	0.72	1.12	1.69	2.63	4.04	5.42

Table 6. Results of analysis of combined dosage on biochemical indicators of tea buds

Unit: %

Tea on Soil sampling	Tanin (%)	Soluble substance (%)	Axit amin (%)	Reducing sugar (%)	Total protein (%)
Tea 1	31.65	41.25	2.80	2.27	0.53
Tea 2	31.40	40.85	2.64	2.39	0.49
Tea 3	31.59	42.70	2.27	2.48	0.48
(Control)	32.20	41.64	2.23	2.46	0.26

(Analysis results in 2020)

In general, the analytical experiments showed a decrease in tannin content, an increase in solutes, a decrease in amino acids, an increase in reducing sugars, and a decrease in protein, which means that the quality of tea has been somewhat improved. In particular, the indexes are relatively high for the Tea 3 sample.

4. Conclusion

The analysis areas of the soil samples showed that the effect of the Recipe 3 sample area on the growth of the tea plants was the highest and gave the best growth. The research results showed that the growth in bud length of LDP1 variety changed over time as follows: in the first 15 days there was no significant difference between treatments, Tea 2 (2.65 cm) had the growth rate was higher than the control formula, the lowest was the control formula (1.69 cm). From day 30 onwards, the formulas had fairly rapid growth, Tea 2 had the highest superiority at 6.45 cm, 1.03 cm higher than the control, and the control Tea 3 was still the lowest formula (5.42 cm). The above results show that Tea 3 is the formula with the highest growth in lobe length. The results of tea quality assessment showed that the Tea 3 areas showed that the actual yield in the experimental treatments ranged from three acres of soil in an area with different soil properties. The Thereby, it was found that the soil in sampling area 2 at the tea garden of Hao Dat company in Tan Cuong commune is the most suitable and sets high economic efficiency for tea plants in the area. Contributing to improving the efficiency of tea cultivation by using mineral organic fertilizers, limiting environmental pollution, towards safe and sustainable tea production.

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