

Effect of Soil Moisture Content on Growth, Crude Drug "Cho-to-ko" Yield and Oxindole Alkaloid Content of *Uncaria rhynchophylla*¹⁾

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Abstract

Uncaria rhynchophylla was cultivated by using soil with various moisture contents (20, 40, 60, 80 or 100% of the maximum moisture content retained by soil). Both growth and crude drug "Cho-to-ko" (dried stem with hooks of *U. rhynchophylla*) yield of the plant were in the following order: 60% > 80% > 40% > 100% > 20%, while oxindole alkaloid content of the stem was in the following order: 20% > 60% > 100% > 40% > 80%. It is concluded that moderately wet soil is suitable for cultivation of *U. rhynchophylla*, in spite of the description in a Chinese literature that sandy soil is good for cultivation of the plants.

Key words

Uncaria rhynchophylla, Rubiaceae, soil moisture content, growth, crude drug yield, oxindole alkaloid content.

Introduction

The dried stem segments with hook of *Uncaria rhynchophylla* (MIQ.) MIQUEL (Rubiaceae) are called "Cho-to-ko" in Japanese and have been used as a spasmolytic, analgesic, and hypotensive agent in Chinese "Kampo" medicine. Four oxindole alkaloids (isocorynoxine, isorhynchophylline, corynoxine, and rhynchophylline) were isolated from the crude drugs²⁾ and have been reported to have such pharmacological activities as central depressive, antiarrhythmic, hypotensive, and Ca²⁺-channel-blocking actions^{3,4)}.

Though *U. rhynchophylla* distributes throughout the western part of Japan⁵⁾, domestic production of the crude drug "Cho-to-ko" has not yet been accomplished. The cultivation of this plant is essential for stable supply of the crude drug. It has been reported in Chinese literature "Zhongyao Dacidian"⁶⁾ that fertile sandy or soil which drains well is suitable for the cultivation of *U. rhynchophylla* plants. Nevertheless, in Japan the wild plants of *U. rhynchophylla* grow in the wet shade of trees by mountain streams. The present study was designed to clarify whether sandy or wet soil is suitable for cultivation of *U. rhynchophylla* by cultivating the plants in the soil with various moisture contents and evaluating their growth, crude drug yields, and oxindole

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alkaloid contents.

Materials and Methods

Plant material and cultivation

Seeds of *U. rhynchophylla* collected from the wild plants in Nagasaki Prefecture on December 25, 1984 were sown and germinated in the greenhouse. The plants were transplanted on May 6, 1986 to Wagner Pots (size: 1/50 m²) containing 1: 1 mixture of volcanic ash soil and compost whose moisture content were adjusted to be 20, 40, 60, 80 or 100% of the maximum moisture content retained by the soil. The soil moisture content in the each pot was adjusted every 1 or 2 days by supplying water to the each level until the plants were harvested on December 2, 1986. Stems of the harvested plants were cut at the center of the internodes and dried at 60°C for a day and stored in a desiccator.

Quantitative analysis of alkaloids

Extraction and quantitative estimation of the alkaloids were carried out according to the method described by Yamanaka *et al.*⁷⁾.

Results and Discussion

Morphological characteristics of the plants at harvest were shown in Table 1. All the morphological characteristics of the plants cultivated in the soil of 60% relative moisture content were shown to be highest,

Table 1. Morphological characteristics of *Uncaria rhynchophylla* cultivated in the soil with various moisture contents

Soil moisture content (%)	Plant height (cm)	Number of branches	Number of branches with hook	Number of hooks	Dry wt. of whole plant (g)	Dry wt. of crude drug (g)
100	40.2±2.1	8.3±0.6	4.1±1.2	9.1±3.7	33.0±3.2	0.6±0.3
80	54.1±4.2	11.9±1.1	8.7±1.1	33.6±5.5	65.5±8.4	3.4±0.8
60	61.9±3.7	13.0±1.0	11.0±1.0	44.7±3.0	74.0±7.1	4.9±0.5
40	51.2±4.1	10.8±1.0	8.2±1.5	31.8±6.9	51.5±9.7	2.9±0.7
20	33.5±2.5	7.3±0.8	2.3±1.0	8.2±8.0	17.8±4.1	0.3±0.2

Each value represents an average with a 95% confidence limit from 20 replicates.

while those of the plants cultivated at 20% soil moisture content to be lowest.

The total oxindole alkaloid contents of the crude drug "Cho-to-ko" prepared from the plants cultivated in the soil with various moisture contents are shown in Fig. 1. Although the total oxindole alkaloid content was highest at 20% soil moisture content and relatively higher at 100% soil moisture content, there seem to be due to the strong repression of the plant growth because of the very dry or wet soil condition, as shown in Table 1. The alkaloid content of the plants cultivated in the soil of the moisture content of 60% was significantly higher than those of the plants in the soil of 40 or 80% moisture content. The individual alkaloid contents of isocorynoxine, isorhynchophylline, corynoxine, and rhynchophylline of the crude drug "Cho-to-ko" cultivated in the soil with various moisture contents are shown in Fig. 2. No significant difference in the oxindole alkaloid composition of the plants cultivated in the soil with different moisture content was observed, and the individual alkaloid contents were shown to be in the following order: isocorynoxine > isorhynchophylline > corynoxine > rhynchophylline.

From these results, it is shown that the optimum soil moisture content is around 60% of the maximum water content retained by the soil for both plant growth and alkaloid production. Therefore, in conclusion, it is suitable to cultivate *U. rhynchophylla* plants in rather wet soil, in spite of the description in the Chinese

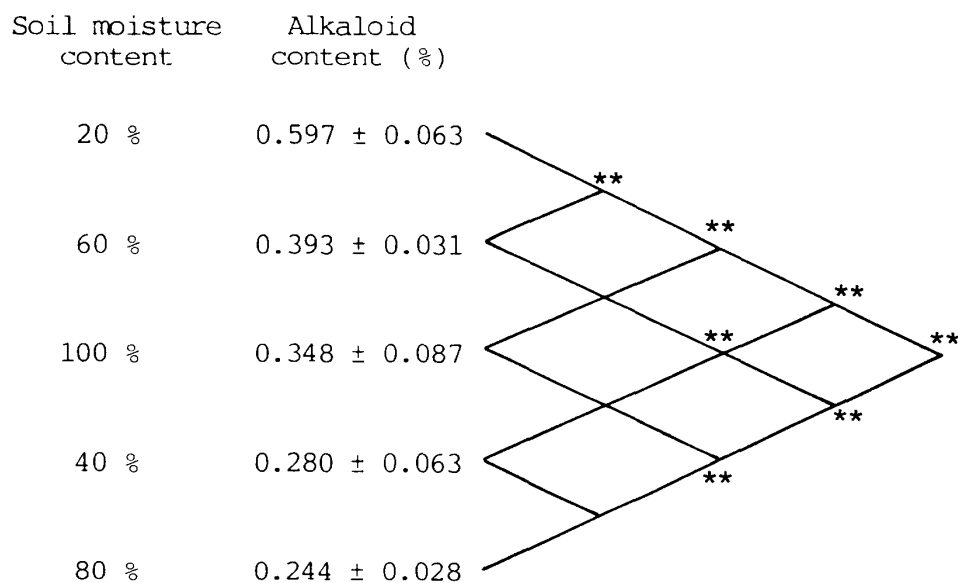


Fig. 1. Total oxindole alkaloid content of *U. rhynchophylla* cultivated in soil with various moisture contents (%). Each content represents a mean with a 95% confidence limit from 3 replicates. Stars (**) indicate that these averages are significantly ($p < 0.01$) different one another.

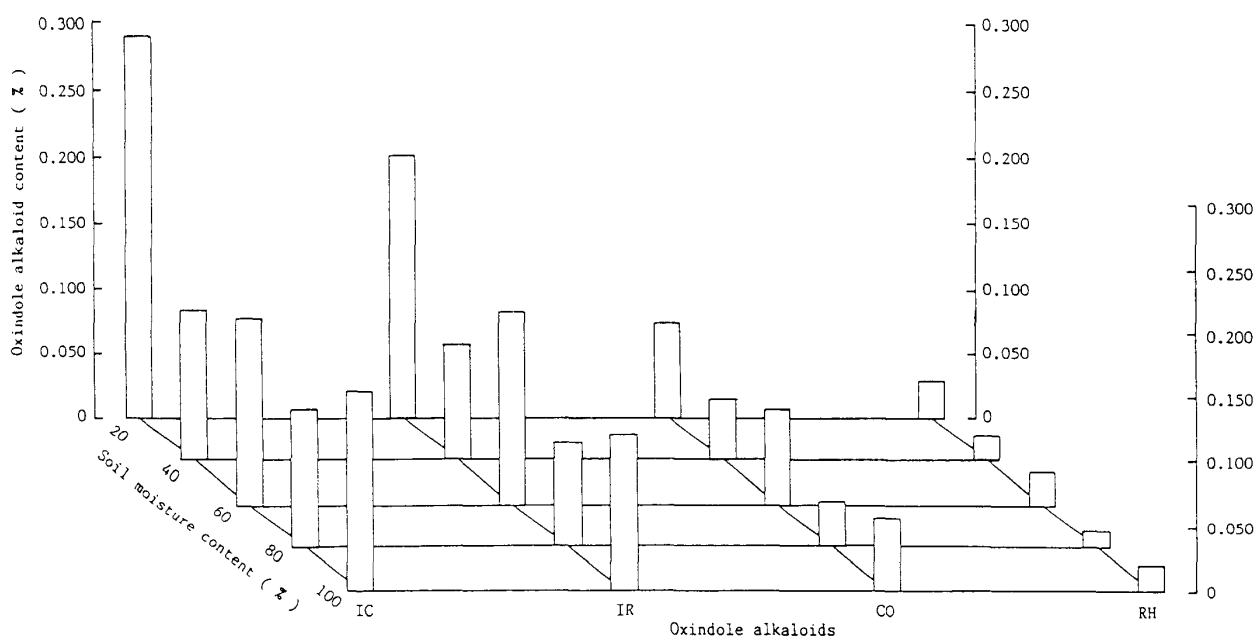


Fig. 2. Oxindole alkaloid compositions of the stem segments of *U. rhynchophylla* cultivated in soil with various moisture contents.

IC: isocorynoxine, IR: isorhynchophylline, CO: corynoxine, RH: rhynchophylline.

literature⁶⁾.

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