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VEGETATION, SOIL SURVEY AND ANALYSIS AT OKINAWA, JAPAN

BY

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ABSTRACT

Soil, vegetation survey and analysis were carried out at Yona. Results from soil physical analysis showed that percolation, total porosity, fresh soil water content, moisture content of air-dry soils and roots decreased with depth from soil surface. However, bulk density , specific gravity and clay content of the soils increased with depth. Two soil textures were identified, light clay and heavy clay.

Results from chemical analysis showed that cation exchange capacity, calcium, magnesium, potassium , sodium, available phosphorus, carbon and nitrogen were highest in horizon A. However, carbon to nitrogen ratio increased with depth from the soil surface. PH in water was one unit lower than pH in potassium chloride.

Results from soil survey showed two soil types : dry yellow soils, granular and nutty structure type (Y_B) and weakly dried yellow soils (Y_C).

Vegetation survey showed high species diversity in the shrub and less than one metre height (herb) and a low tree volume in the survey site.

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1. GENERAL INTRODUCTION

Forests have been considered as indispensable resource for human life because of their multiple uses in Japanese history. Therefore, Japanese learnt the importance of conservation and sustainable utilization of forests many years ago (Forests and Forestry in Japan, 1997). At present, two-thirds (67%) of Japan are covered with forests and Japan is regarded as one of the most forested countries in the world. Among temperate countries, only Finland surpasses Japan in terms of forest cover.

Japan has done a lot of forest management and reforestation. With these efforts, Japan has approximately 25.15 million hectares (ha) of forests, consisting of 10.40 million ha of man-made forests and 13.38 million ha natural forests, covering 41 % and 54 % of total forest area respectively. Existence of about 10.40 million ha of man-made forests in Japan is unique in the world. Growing stock of man-made forest is 1,892 million cubic metres while that of the natural forests is 1,591 million cubic metres.

Most of the species of man-made forests are coniferous trees such as Sugi (*Cryptomeria japonica*), Hinoki (*Chamaecyparis obtusa*), Karamatsu (*Larix leptolepis*) and *Pinus* spp. Sugi and Hinoki which produce high quality timber for building are major plantation trees in Japan. Sugi make up 44 % of the total man-made forest area while Hinoki make up 24% . Afforestation of broad-leaved trees is not so effective as the cover only 2 % of the total forested area.

In Japan, the climax vegetation is mainly forests, reflecting a warm and monsoon climate with high rainfall. However, species composition and distribution of forest types differ from region to region because of climate differences caused by Japan's long and narrow land stretching from north to south and sharp mountain ranges running middle of the land with altitude of more than 3000 metres (map 1).

Natural forests consist of various species especially braod-leaved trees like Buna (Fagus spp.), Nara (Quercus spp.), whose growing stock occupies 70 % of total growing stock of the natural forests.

Japan is exposed to earthquakes, typhoons and blizzards. Therefore, forests perform an indispensable role in safeguarding human life, property and soil against these natural disasters. It is well recognized that forests have multiple uses. "Basic Plan for Forest Resources" classifies Japanese forests into four main types along with their expected functions:

(i) Prevention of disaster in hilly areas.

(ii) Conservation of water sources.

(iii) Conservation of peoples living environment.

(iv) Provision of cultural and recreation activities.

The economic annual value produced through these functions for public benefits is estimated at about 39,200 billion Yen (US$ 334 billion as of August 1997) (Forests and Forestry in Japan, 1997) excluding the value of the absorption and fixation of carbon dioxide. It is important to note that about 20 % of total carbon dioxide (CO_2) emitted in Japan is absorbed by the Japanese Forests.

Ownership of the Japan Forests can be classified into three major categories, private (16.6 million hectares), public (2.7 million hectares) and national forests (7.6 million hectares).

Japan has a monsoon climate and experiences distinct seasonal changes of four seasons: spring, summer, autumn and winter. Air temperature ranges between 6 °C and 22 °C. However, meteorological conditions vary because of the latitudinal differences which divide the forests into six types. Moreover, high mountains run through the centre of the country and it is possible to find vertical variation in forest types even in areas at same latitude. Thus forests are extremely rich in variation. The six forest types in Japan are:

(i) alphine zone forests, (ii) sub-frigid forests,

(iii) cool temperate coniferous forests mixed with broad-leaved trees,

(iv) cool temperate forests,

(v) warm temperate forests and

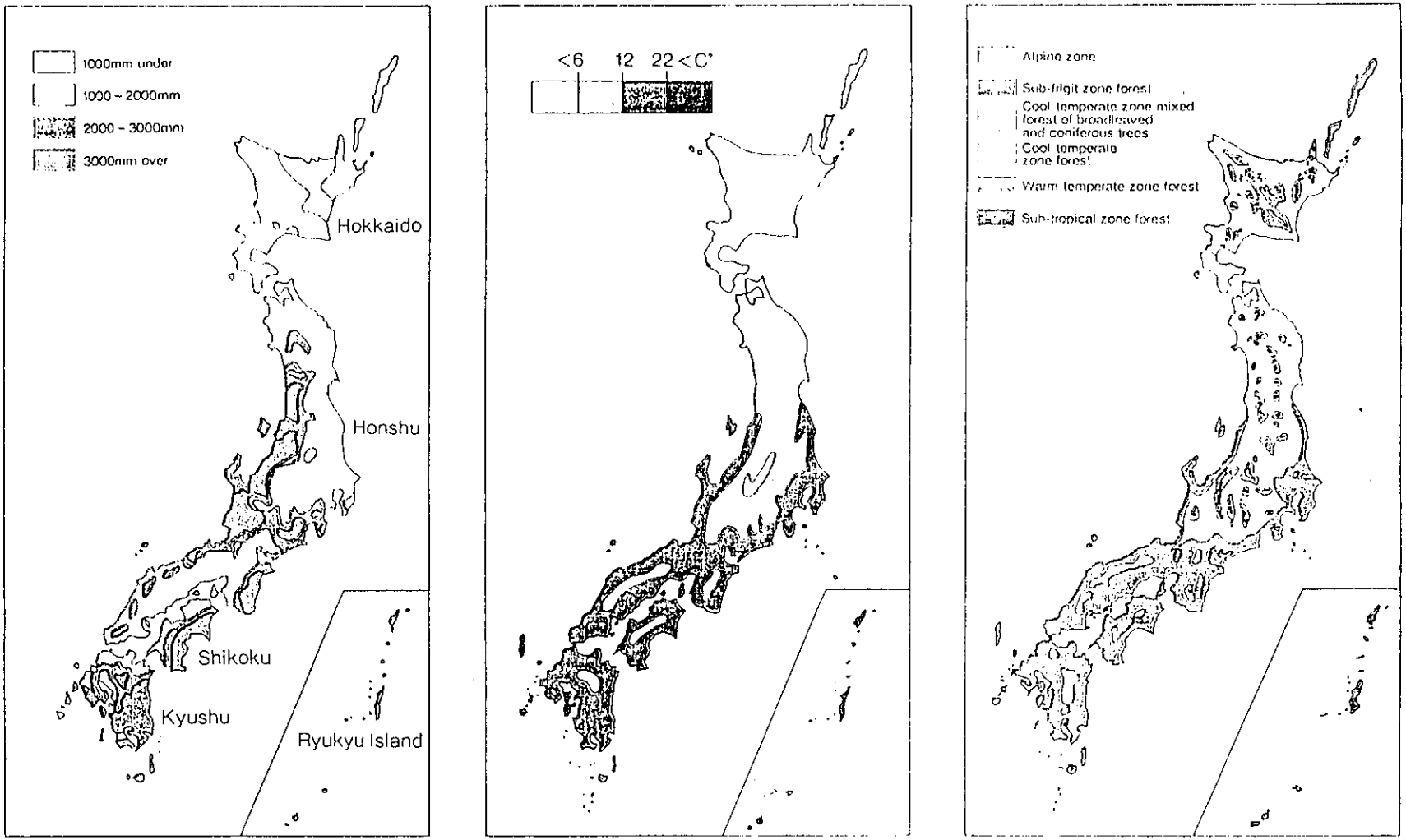
(vi) sub-tropical forests (map 1).

Japan has an annual mean rainfall of 1,700 mm. This amount is twice global annual average (Forestry in Japan). Rain season occurs from June to July, while the typhoon (violent tropical storms) risk is greatest in September. An

average of ten typhoons per year strike Japan which lies directly in the path of these violent tropical storms originating near the equator. The intense rainfall from typhoons cause enormous damage to life, homes and public infrastructure.

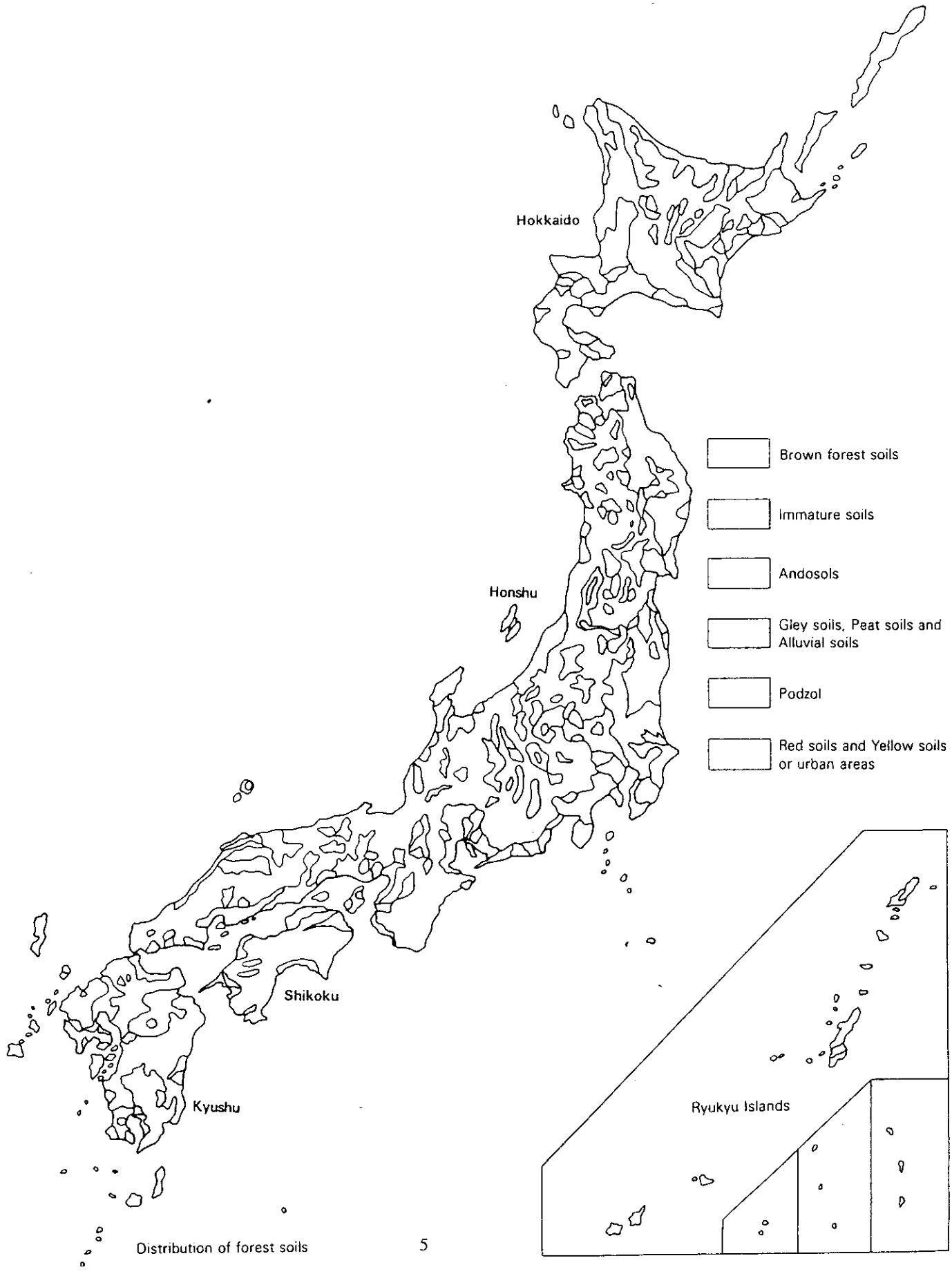
Mountain ranges comprising the central backbone of the country occupy 70% of the land area. Downstream run-off from this rugged terrain leads to frequent floods and landslides. This condition is further aggravated by damage from volcanoes. Japan has 83 active volcanoes, accounting for 10 % of all active volcanoes in the world.

Weather in Japan is variable, and, geology and topography are complicated. Therefore, a variety of forest soils are found. The most widespread soil is brown forest soil which covers about a half of the entire forest land. Other important forest soils are: black, podozolic, red, yellow, gley, peaty, dark-red and immature soils (map 2).



Map 1. Annual rainfall, temperature and forest distribution in Japan

Map 2. Distribution of forest soils in Japan



1.1. Study area

Okinawa Prefecture, located at southernmost and westernmost of Japan, in latitude 26 °N and longitude 127 °E, consists of Ryukyu Archipelago made up of many islands spreading over 350,000 square kilometres (km^2)of the waters, Okinawa Islands, Saki-shima Islands and Daito Islands. Its total area is 224,587 km^2 accounting for 0.6 % Japanese territory (Onaga, 1991). Ryukyu Archipelago which extends as far as 1,000 km in length is classified as Ryukyu arc in terms of geology. Every island included in this arc has its own peculiar topography and geology.

Okinawa belongs to the sub-tropical zone 4. It lies in latitude 24° to 28 °N with an annual precipitation range of between 2,100 to 2,500 mm. Relative humidity ranges between 70 to 80 throughout the year. Typhoons have a potential influence on the climate of Okinawa. With their frequent visits to Okinawa, typhoons have constant impact on climatic condition of the island.

Although Okinawa region is generally characterised as a rainy region, it has often suffered from drought damage because of wide annual rainfall fluctuations. Historical records indicate that, Okinawa suffered three severe famines due to drought in 1709, 1825 and 1832. Okinawa is likely to suffer from drought when it has a monthly precipitation less than 65 % of that of the normal year or an annual precipitation less than 1.500 mm.

Okinawa is characterized by the geological structure of the following three different geological zones extending in parallel with Ryukyu Archipelago:

(i) Paleo young volcanic zone, inner zone.

(ii) Paleo rock zone, middle zone, which consists of mid-paleozoic strata or igneous rocks.

(iii) The tertiary zone, outer zone, which are of tertiary formation and the young structure.

The distribution and characteristics of the soil in Okinawa reflect geological features and parent materials. Appendix 1. shows the main soil types of Okinawa.

The study under review was carried out at Yona, University of the Ryukyus Experimental Forest station. Yona is located in the northern part of Okinawa Island, 26°N 45 ' 30 N, 128 ° 05' 00 E, 10 m above sea level. A five-year weather data collected from the station showed that Yona has a mean annual temperature range of between 20.8 and 22.3 °C with lowest temperatures from December through February. The same data revealed a mean annual precipitation range of between 1830 mm and 2762 mm, with a minimum in December and maximum in August.

The objective of this study was to determine soils and vegetation distribution in the area. The study also aimed at carrying out both physical and chemical analyses of soils collected from selected sites of the study area.

2. MATERIALS AND METHODS

2.1. MATERILALS

Topographic map of the survey area
Soil sample cylinder (volume: 400 ml)
Standard soil colour chart
Pruning scissors
Transplanting trowel
Plastic bags for soil samples
Plastic adhesive tapes
The cylinder soil samples of the survey site
Pans for water saturation
Precision balance (chemical balance)
50 ml and 100 ml beakers
Measuring Cylinders (graduated cylinders)
Oven
Picnometers (specific gravity bottles)
Soil percolation apparatus
Weighing bottles (Volume: about 34 ml)
Washing bottles (squeeze bottles)
500 ml tall beakers
Watch glasses
Kohn type soil sedimentation apparatus
Glass rods with rubber caps
100 ml centrifuge tubes
500 ml shaking bottles with rubber caps
200 ml evaporating dishes
6% Hydrogen peroxide
50 ml polyethylene Centrifuge tubes
500 ml plastic bottle with small cap
Volumentric flasks (1,000, 500 and 50 ml)
Volumentric pipettes (2,4,6,8,10,25,50 ml)

Clinometer
Ruler
Knife for soil sampling
Scoop (shovel)
Hole
Filter papers
Paraffin papers
Porous plates
Top pan balance
Sheets of gauze
Spoons
10 mm wire mesh sieves
Evaporating dishes
Hot plate
Forceps
Desiccators
Gloves
hot plate
Shaker
Thermometer
Centrifuge
Weighing bottles
Washing bottles
Siphons
1N Sodium hydroxide
Vibrator
Spectrophotometer
Funnel stands
Shaker

Ammonium acetate solution
Ammonium chloride solution
Potassium chloride solution (1 M)
Salicylate nitropruside solution
Buffer hypochloride solution
Calcium Standard solution (50 ppm w/v)
Magnesium Standard solution (25 ppm w/v)
Sodium standard solution (25 ppm w/v)
Potassium standard solution(50 ppm
Methyl alcohol (80 %)
Acetone solution (95 %)
Silver nitrate solution (0.1 M)
SodiumEDTA
Potassium phosphate solution
5,000 ppm solution (w/v)
Funnels
Atomic absorption unit

2.2. METHODS

2.2.1. SOIL PHYSICAL ANALYSIS

2.2.1.a. Pit preparation and soil sampling

Soils were collected from soil profile pits that were prepared as described by Baba and Enoki, 1998.

Cylinder soil samples for physical analysis were taken from each horizon, starting from the topmost horizon (horizon A) as described by Baba and Enoki, 1998. In addition, soils for chemical analysis were also collected from each horizon. Direction and inclination angle of the slope, soil type, deposits, bedrock, soil profile horizons, boundaries, soil colour, horizon depth, humus content, gravel, soil texture, soil structure, soil hardness, pore composition, soil moisture content, eluviation and illuviation, mycorrhiza and rhizomorph, and roots were described as shown in appendix 2, field notes for forest soil survey.

2.2.1.b. Soil weight, Percolation Rate, dehydration and Three Phase Distribution

Soil physical properties are intimately correlated to plant nutrient retention, ease of plant roots penetration, soil aeration, soil hardness (rigidity), soil drainage, soil moisture storage capacity. Usually, many apparatus and complicated machines are used for soil physical analysis making it difficult to study most techniques of soil physical analysis within a couple of weeks.

However, in this study, simple but very useful technique for actual forest soil survey, a soil cylinder sample was used.

Soil percolation rate is one of the most important indexes of soil physical aspects and is categorized as good (more that 100 ml/min), moderate (50 ml/min to 100 ml/min) and poor (less than 50 mil/min). However, some soil types percolate more than 300 ml/min, others less than 10 mil/min while others do not percolate at all.

In the laboratory, the soil cylinders were weighed on top pan balance and weights of fresh soils determined. The sample cylinders were then saturated in water pans for 24 hours after which saturation weight was determined. Sample water percolation was recorded at 5 and 15 minutes as described by Baba and Enoki, 1998.

Dehydration on a porous plate is used to calculate soil porosity (pore composition), the total pore space in a soil. During dehydration, water in the coarse pores is dehydrated leaving behind water in fine pores. The pF of the porous plate is 2.7, which allows water from the coarse pores to be dehydrated into the plate. After percolation determination, the cylinder samples were placed on porous plates (previously dried for 24 hours at 105 -110 o C and cooled at room temperature) for 24 hours. After 24 hours, the cylinders samples were weighed on a top pan balance and net dehydrate weight was determined.

The contents of the cylinders were soil, gravel, roots and air. Soil, gravel and roots are solids. Therefore the contents of the cylinders can be divided into the solid phase as soil, gravel and root; Liquid phase as water and aerial phase as air (pores). The composition, solid phase (solid volume or solid weight); the liquid phase (liquid volume or liquid weight) and the aerial phase (aerial volume or aerial weight) in the cylinders are called "three phase" distribution. To determine the composition of the cylinder contents, the cylinders were oven dried for 24 hours at 105 - 110 o C and the cylinder contents oven dry weight determined. Then the oven dry weight of gravel, root and soil were determined.

2.2.1.c . Specific gravity of gravel and soil particles

Specific gravities were required to calculate the volumes of gravel and soil particles in the soil cylinders (total cylinder volume was 400 ml). The following weight, volume and specific gravity relationship was used to calculate the volumes of gravel and soil:

Weight = Volume x specific gravity

Volume = Weight / specific gravity

To determine the specific gravity of gravel and soil particles, picnometers were used. About 5 g of soil and gravel were precisely weighed on a chemical balance into the picnometers. Specific gravity of gravel and soil was the determined as described by Baba and Enoki, 1998. Using the specific gravities, volumes of soil and gravel were calculated while volume of the root was determined by multiplying the root oven dry weight with 2.34 (a constant obtained from long term Japanese root study experience).

2.2.1.d. Determination of the soil moisture content and the moisture factor

Air dried soils were sieved through 2 mm mesh sieves and about 5 g of the soils weighed precisely into weighing bottles which had been oven dried for 5 hours and cooled in a desiccator for more than 30 minutes. The bottles were then oven dried at 105 - 110 °C for more than 24 hours, cooled in a desicator for more than 30 minutes and weighed in a precision balance. Moisture content and soil moisture factor were then computed.

2.2.1.e. Particle size analysis (Mechanical analysis)

Soil texture depends on the composition of clay, silt and sand. If actual content of the three soil components are known, soil texture can be automatically decided on. Therefore to determine soil particle size composition exactly 10.0 g of air dried soils (< 2 mm) were weighed on a chemical balance into 500 ml tall beakers. 40 ml of 6 % hydrogen were added to decompose organic matter in the soils. Coarse sand, fine sand, silt and clay were separated as described by Baba and Enoki, 1998. Their respective constituents were then computed from which soil textures were determined.

2.2.1.f. Soil Carbon and Nitrogen Determination

Carbon and nitrogen are macronutrients. Carbon content gives an indication of organic matter in the soil. Nitrogen is used by plants as a building block for plant proteins and in low levels plant growth is significantly retarded. To determine carbon and nitrogen in the soils, a CN analyser was used. The following weights were taken precisely:

Horizon	Weight (mg)	Weight (g
A	300	0.30
B	600	0.60
C	600	0.60
Hippuric acid (standard)	600	0.60
Cobalt Oxide		4.00

4 g cobalt oxide (blank and temperature stabilizer, maintains CN analyzer temperature between 830-850 ° C during carbon and nitrogen determination), were weighed on a top pan balance. The cobalt oxide was added to each soil sample and mixed well with a spatula. The mixture was packed into a CN analyzer sample holder and C and N were read in a CN analyzer. Hippuric acid, standard, had percentage Carbon 60.33, and percentage Nitrogen 7.82. Cobalt oxide was used as a blank and temperature stabilizer (830 - 850 ° C) for the soil samples.

The results of the soil physical analysis were summarized as shown in table 1.

2.2.2. SOIL CHEMICAL ANALYSIS

2.2.2.a. Soil Handling and preparation for chemical analysis

Handling soil samples in the laboratory involves procedures of drying, grinding, sieving, mixing, partition and storing. Thus soils are prepared for chemical analysis.

Soil samples for chemical analysis were air-dried at room temperature at about 20 to 25 °C and relative humidity of 20 to 60 %. The samples were evenly spread in paper-lined shallow baskets immediately after bringing them from the field. All clods were broken when the soils were still moist and the soils were air-dried for more than 7 days.

Before chemical analysis, the soil aggregates were broken up by grinding lightly with a rolling pin, taking care not to crush gravel. The ground samples were then sieved through 2 mm (9 mesh) wire sieves. Grinding and sieving were repeated for unbroken soil aggregates remaining on the screen and fine earth (< 2 mm) was separated from gravel (> 2 mm). The collected gravel and fine earth were weighed and their percentage weight computed.

The sieved soil samples were placed on sheets of paper and mixed by a process of rolling and turning as described by Oya *et al.*; 1998 and transferred into screwcap jars and stored in the laboratory.

2.2.2.b. Determination of the Soil pH
(Using glass electrode pH meter)

The pH value of many soils varies with seasonal conditions and soil management practices. pH is a reflection of present soil chemical status and has a significant meaning in agricultural practices. It is therefore important to know the pH value of soil under investigation. In this study, soil pH was determined using both water and potassium chloride (KCl).

pH of the soils were determined at a soil to water ratio of 1 to 2.5 (w/v). About 20 g of soil were weighed into 100 ml vials and 50 ml of distilled water added. The solutions were shaken for 30 minutes on a shaking machine and allowed to settle until clear supernatant and suspension were obtained in the vials. The pH of both the supernatant and suspension were taken at the same time using a glass electrode pH meter, which also recorded the solution temperature. The pH obtained was expressed as pH(H_2O).

In order to overcome relative changes in salt content, specifically of leached soils, 1M KCl is used instead of distilled water. Exchangeable hydrogen ions are involved in this measurement. Thus the pH values determined by this

procedure are more or less 1 unit lower than that with water in most cases. Measurement of pH in KCl was the same as that in water but was expressed as pH(KCl).

2.2.2.c. Water Content and Moisture Factor of Soils

Water is an important constituent of soil. Water content has a close relationship to some of the soil properties. Water content is expressed on oven-dry soil weight in most cases, especially in the cases of soil chemical analysis, though various determinations are done on air-dry basis. Moisture factor is used in conversion of analytical values determined on air-dry soil to oven-dry soil basis.

To determine soil moisture and soil moisture factor, weighing bottles were oven-dried for 5 hours at 105 ° C, cooled in a desiccator for 30 minutes and weighed. About 5 g of soil were put in the bottles and final weight taken on a chemical balance. The bottles containing air-dried soils were dried in oven for 5 hours at 105 ° C to remove all water contained in the soils. The weights of the oven dry soils were taken after cooling the bottles in a desiccator for 30 minutes. Percentage moisture content and soil factor were then computed. The soil moisture factors were used to convert the analytical values obtained using air-dry soils to that of oven-dry soil conditions (the values were multiplied by the soil moisture factor).

2.2.2.d. Cation Exchange Capacity (CEC) and Exchageable Bases (Using Ammonium Acetate for Saturation)

Cation exchange capacity (CEC) may be defined as the soil's capacity to adsorb exchageable cations. It is an important measure of soil's capacity to store plant nutrients and store (hold) water.

In this method of CEC determination, the soils were saturated with ammonium in ammonium acetate and the ammonium ions (NH_4^+) adsorbed on soil components were replaced by potassium ions (K^+). The amount of the ammonium ions replaced were determined and regarded as the CEC of the soil.

2.2.2.e. Extraction solution for exchageable bases and CEC Saturation of soil with ammonium ion.

4 g of air-dried soil (< 2 mm) were weighed into 50 ml polythene tubes and 40 ml of 1 M , pH 7.0, ammonium acetate solution (CH_3COONH_4) added. The tubes were capped, vibrated (for 1 minute), shaken horizontally on shaking machines for 10 minutes and centrifuged at 2,500 rpm for 10 minutes. The clear supernatants were transfered to 200 ml volumentric flasks. The process was repeated two more times. On the fourth time, 20 ml ammonium acetate and 20 ml ammonium chloride (NH_4Cl) (1 M, pH 7) were added and the process of vibrating, shaking and centrifugation repeated. The supernatant was added to the 200 ml flask. The supernatant solutions in the flask were made up to 200 ml mark with distilled water and transferred into 250 ml plastic bottles and kept for the determination of exchageable bases.

2.2.2.f. Removal of excess salt with alcohol

40 ml of 80 % methyl alcohol (CH_3CH_2OH) were added to the soils in the centrifuge tubes. Vibration, shaking and centrifugation were applied as above. On the third round, 40 ml of 95 % acetone, propanone (CH_3COCH_3) were added. Vibration, shaking and centrifugation were applied. After centrifugation, 2 tubes were taken per soil sample and sample supernatant added. A drop of silver nitrate was added to one of the tubes. If the sample formed a white precipitate, the process was repeated until the supernatant formed no precipitate with silver nitrate.

2.2.2.g. Replacing ammonium ion by potassium

40 ml of 1 M potassium chloride (KCl) solution were added to the centrifuge tubes containing the excess salt free soil. 1 minute Vibration, 10 minutes shaking and 10 minutes centrifugation were applied. The supernatants were collected into 200 ml vulumentric flasks. This procedure was repeated three more times and the supernatant made into 200 ml mark with distilled water. The solution was transferred into 250 ml plastic flasks for cation exchange capacity (CEC) determination.

2.2.2.h. Determination of ammonium by spectrophotometry (for CEC determination)

Exchangeable bases (By using atomic absorption unit)

Calcium (Ca), magnesium (Mg), potassium (K) and sodium (Na) were determined as exchageable bases. The elements in available forms are the most available for crops (macro-nutrients). Their availability is an indication of soil fertility except for sodium, which may cause trouble in extreme concentrations especially in saline soils.

In this procedure, the sample solutions were burnt in an atomic absorption unit and concentrations of Ca, Mg, K and Na were read from standard curves drawn from respective standard concentrations. The wavelengths used were 422.7 nm (Ca), 285.12 nm (Mg), 422.7 nm (K) and (Na) 589 nm.

2.2.2. i. Available Phosphorous (Trough Method)

Phosphorous is a macronutrient. It is subject to soil chemical changes. The available forms of phosphorous are HPO_4^{-2} and H2PO$^-$. Its availability is affected by its total quantity and soil chemical properties. Troug Method is applicable to soils poor in available phosphorous and it was used in this study. Available phosphorus was determined using a spectrophotometer at a wavelength of 630 nm.

The results of the soil chemical analysis were summarized an shown in table 2.

2.2.3. SOIL MAP PREPARATION

Soil types of the study site were identified through a soil survey using a topographic map of scale 1cm to 500 m. Then a soil map was prepared, showing the main soil types (map 3).

2.2.4. VEGETATION SURVEY IN SOIL SAMPLING SITES

Distribution of trees species in the sampling sites (100 square metre, circle of radius 5.64 m) were determined. Parameters assessed were: species sociability, tree heights and diameters at breast height. The datas were tabulated as shown in appendices 3 and 4 respectively.

3. RESULTS AND DISCUSSIONS

3.1 Soil Physical Analysis

Results from soil physical analysis (table 1.) indicated that percolation decreased with depth from the soil surface. This was because soil particles in the soil surface were loosely packed due to presence of roots and organic matter. The data also shows that more pores were located on the soil surface. Many pores in the upper soil layers would readily allow water to pass through. However water percolation varied with plot indicating variation in roots, organic matter and pores with plots.

Bulk density generally increased with depth indicating increase in soil weight with depth. This was because of decreased pores, roots and organic matter and therefore increase in soil compaction with depth. However, there was plot to plot variation indicating variation in soil compaction across plots.

Total porosity generally decreased with depth. This was because roots and organic matter composition which contributes to the amount of pores in the soil decreased with depth as indicated by the percentage root and carbon analysis. However total porosity varied with plot due to variation in root and organic matter composition in these plots.

Air minimum had negative values due to expansion of clay in the soils. This was probably because the soils were sampled as mass. In addition, the soils had high clay contents which might have also contributed to the negative values observed.

Water content in the soils (% weight and % volume) during sampling were generally high. This was because it was raining at the time of sampling.

However, both the water weight and volume decreased with depth indicating that more water was held on the soil surface. Water content also varied with plot indicating that different water amounts reach the soil surface because some water is usually held in leaves and trunks of surrounding vegetation.

In three distribution phase, the ratio of solid to liquid was about a unit. This was because it was raining and the soils had a lot of water. However, the volume of air, aerial phase, was low because most of the pores had been occupied by water.

Clay dominated soils in all plots and as a result, only two soil textures light clay (LiC) and heavy clay (HC) were identified in the two soil types Y_B (dry yellow soils) and Y_C (weakly dried soils).

Water contents in the air-dry soils decreased with depth indicating decreasing water holding capacity with depth. In the soil surface, organic matter has a tendency of holding water. Moisture factor was about a unit.

Carbon and nitrogen decreased with depth indicating a decrease in soil organic matter. As a result, carbon to nitrogen ratio (C/N ratio) increased with depth.

3.2 Soil Chemical Analysis

From table 2., gravel in Yona 1 was very little as it was located up the mountain. However in Yona 2, there was a lot of gravel on the A layer because it was located on the slope and creeping must have contributed to the high gravel observed. Yona 3 was located on a riverine and no much gravel was observed.

The difference in pH, in water and potassium chloride (KCl) was about a unit indicating that the soils sampled at Yona were infertile.

High cation exchange capacity (CEC) indicates a high potential for nutrient retention. From the results, horizon A had a high CEC than B and C. This indicated that horizon A had a high capacity to retain nutrients compared to the other horizons. Calcium (Ca), Magnesium (Mg), Potassium (K) and Sodium

(Na) concentrations decreased with depth indicating decrease in soil organic matter from surface to lower soil layers.

Horizon A had noticeable high base saturation compared to all other horizons in all the three plots. However, the base saturation decreased from Yona 1 (top of mountain) to Yona 3 (riverine) indicating increasing soil infertility. This observation is comparable to carbon and nitrogen analytic results (Table 1).

Photographs of soil profiles for six sites (Yona 1 to 6) from which the soils for physical and chemical analysis were sampled (Yona 1, 2 and 3) as well as soil and vegetation survey were carried out, forms part of the results. A Soil map (map 3), prepared from the study site, was also included.

Table 1. Soil Physical Analysis Data

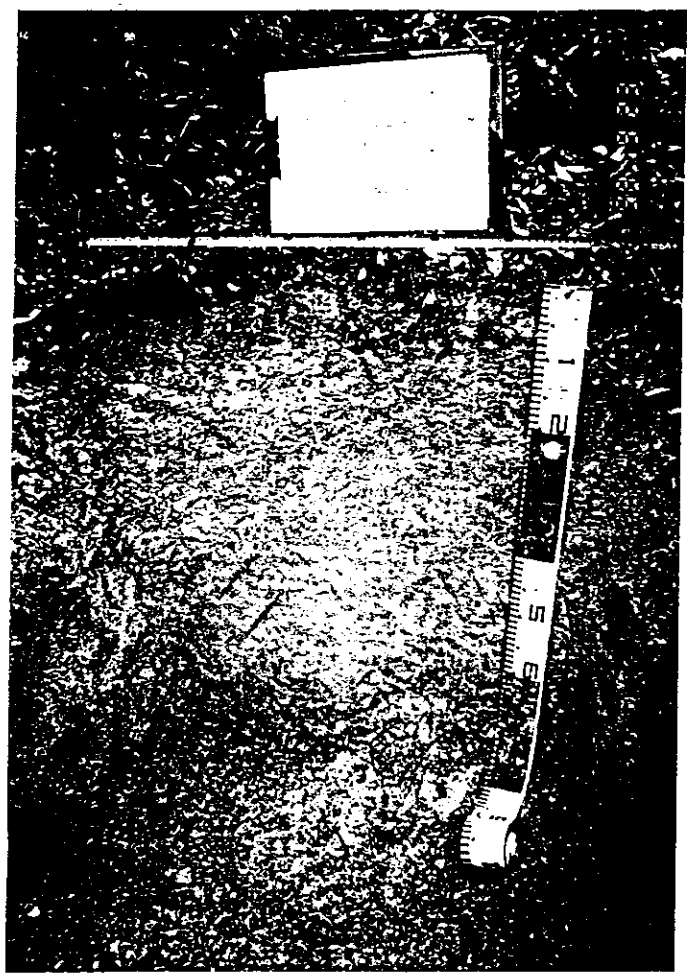
Plot Name	Layer (Horizon)	Percolation (ml)			Bulk Density %	Porosity			Water Maximum		Air Minimum (%)	Water in Fresh soil		Three Phases		
		5 min	15 min	Mean		Coarse (%)	Fine (%)	Total	Weight (%)	Volume (%)		Weight (%)	Volume (%)	Solid (%)	Liquid (%)	Aerial (%)
Yona 1	A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	B1	68	68	68	104	24	33	57	59	59	-2	41	47	43	47	10
	B2	3	3	3	148	6	37	43	34	34	8	31	51	46	51	3
Yona 2	A	-	-	-	77	16	35	51	89	58	-7	69	37	49	37	14
	B	111	109	110	80	47	39	86	89	62	-3	61	33	41	33	26
Yona 3	A	20	21	21	124	24	41	65	55	69	-4	40	49	35	49	16
	B	18	19	19	157	22	34	56	40	64	-8	31	48	44	48	7
	C	5	8	7	165	14	38	52	30	50	2	25	40	49	40	11

Table 1. Continued

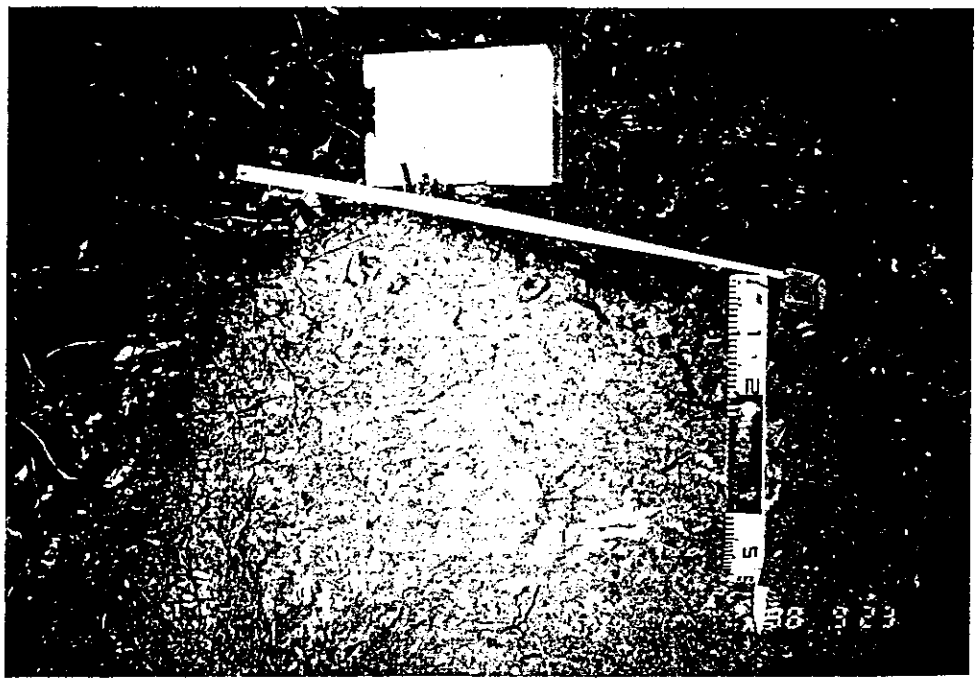
Plot Name	Layer (Horizon)	Depth (cm)	Root (%)	Specific Gravity		Particle Size Distribution				Soil Texture	Soil Type	Soil moisture		Carbon C (%)	Nitrogen N (%)	C/N Ratio
				Soil (g/ml)	Gravel (g/ml)	Coarse (%)	Fine (%)	Silt (%)	Clay (%)			Water (%)	Moisture Factor			
Yona 1	A	0-4	-	-	-	14	26	23	37	LiC	YB	11		13.06	0.55	23.74
	B1	14-20	1	39	2.4	11	21	33	35	LiC	YB	3		2.32	0.09	25.77
	B2	65-75	0	56	0.9	1	15	24	69	HC	YB	2		1.13	0.04	28.25
Yona 2	A	3-7	2	2.0	2.7	16	20	16	40	LiC	YB	15		6.59	0.31	21.26
	B	20-24	0	2.4	2.6	17	21	26	69	HC	YB	4		3.92	0.18	21.78
Yona 3	A	0-4	1	2.3	2.6	11	20	27	41	LiC	Yc	4	1.04	5.94	0.37	16.05
	B	20-24	0	2.5	2.7	13	18	18	52	HC	Yc	3	1.03	2.39	0.14	17.07
	C	45-49	0	2.6	2.6	13	24	9	55	HC	Yc	2	1.02	1.15	0.06	19.17

Table 2. Soil Chemical Analysis Data

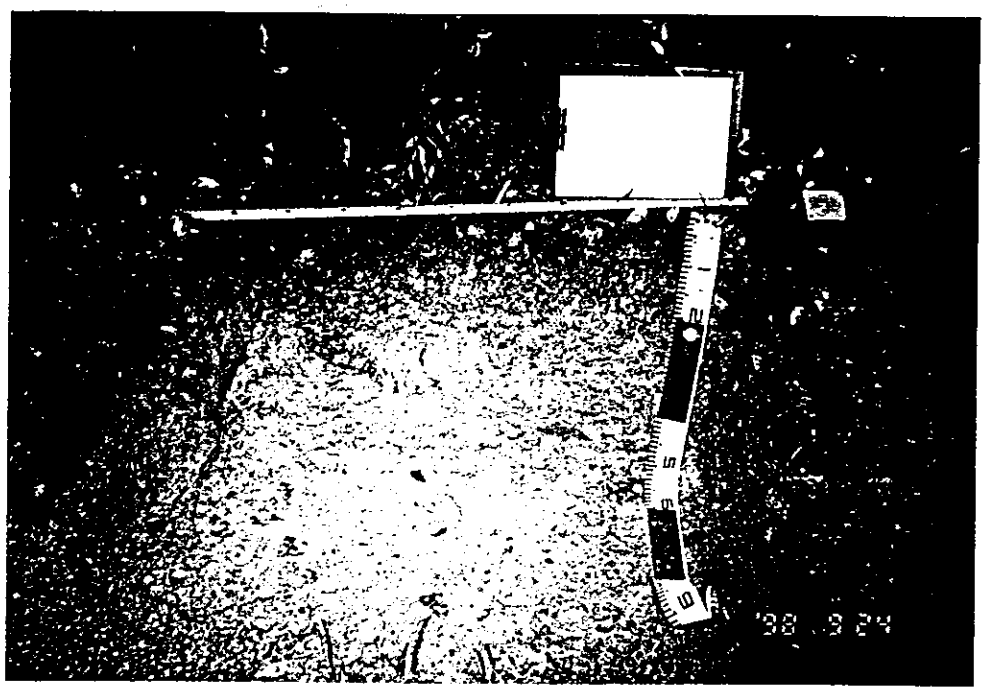
Plot Name	Layer (Horizon)	gravel (%)	Earth (%)	pH		CEC (+)cmol per kg	Exchangeable Base				Base Saturation	Available Phosphorus
				Water	KCl		Ca	Mg	K	Na		
						(+) cmol per kg						
Yona 1	A	0.3	99.7	4.07	3.11	21.20	4.06	3.52	0.29	0.20	38.1	2.00
	B1	1.5	98.5	4.36	3.22	8.51	0.07	0.24	0.04	0.02	4.3	0.20
	B2	1.8	98.2	4.42	3.18	8.29	0.10	0.27	0.04	0.04	5.4	0.13
Yona 2	A	21.1	78.9	4.29	3.19	21.31	2.02	1.71	0.22	0.15	19.2	1.22
	B	2.4	97.6	4.46	3.25	11.72	0.21	0.37	0.08	0.04	6.0	0.18
Yona 3	A	5.3	94.7	4.31	3.24	18.24	0.71	0.99	0.23	0.15	11.4	1.30
	B	7.3	92.7	4.54	3.38	8.67	0.08	0.21	0.07	0.11	5.4	0.60
	C	10.3	89.7	4.57	3.29	7.22	0.08	0.20	0.06	0.08	5.8	trace



Soil Profile - Yona 1



Soil Profile - 2



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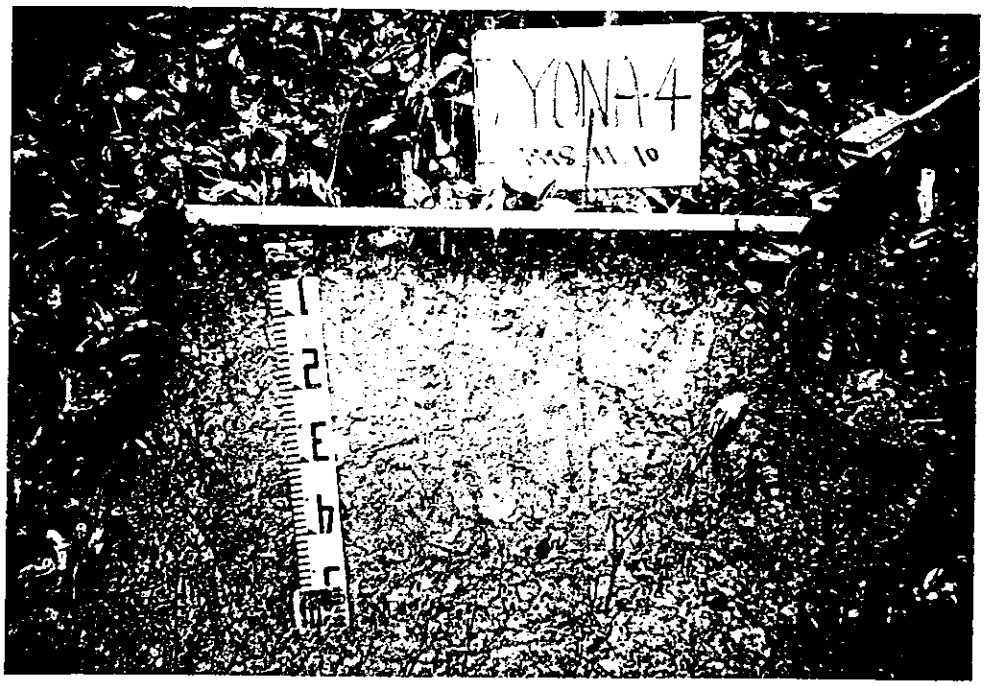

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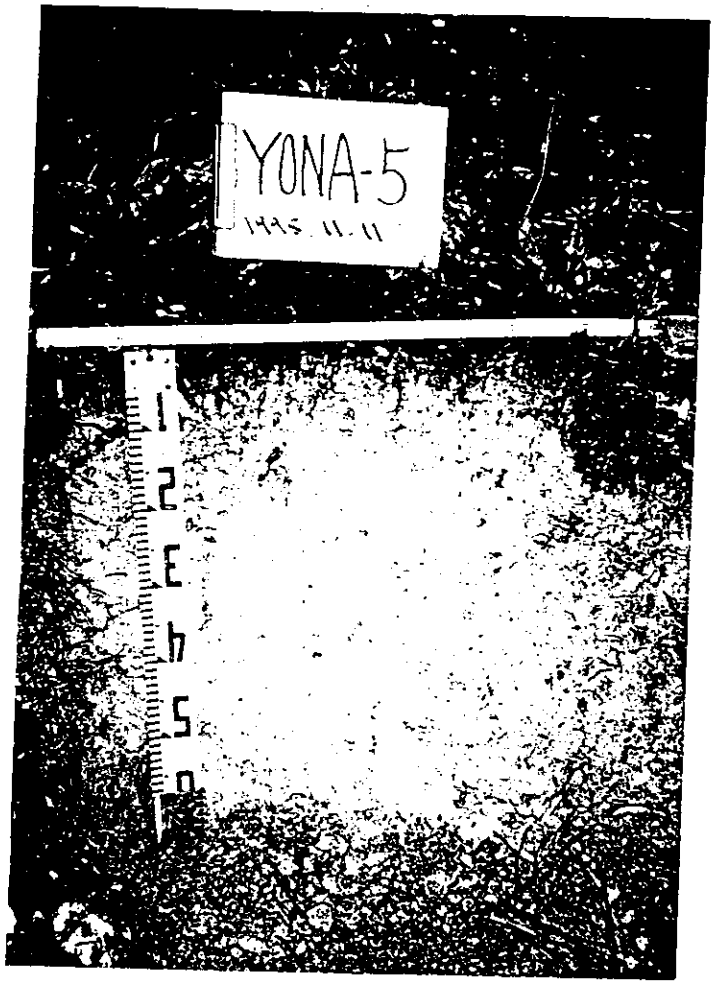

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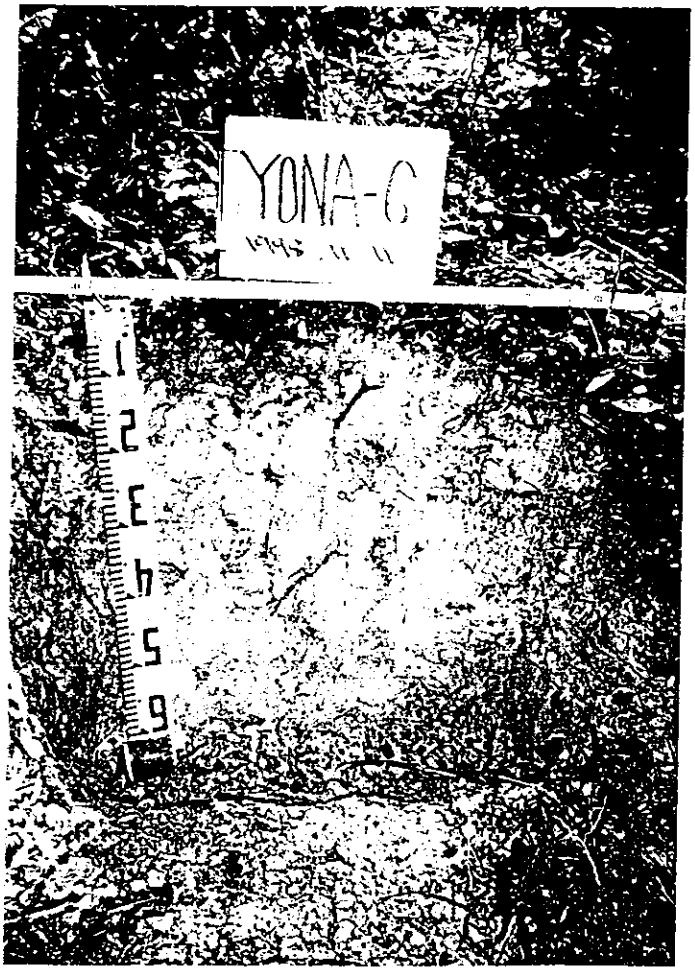
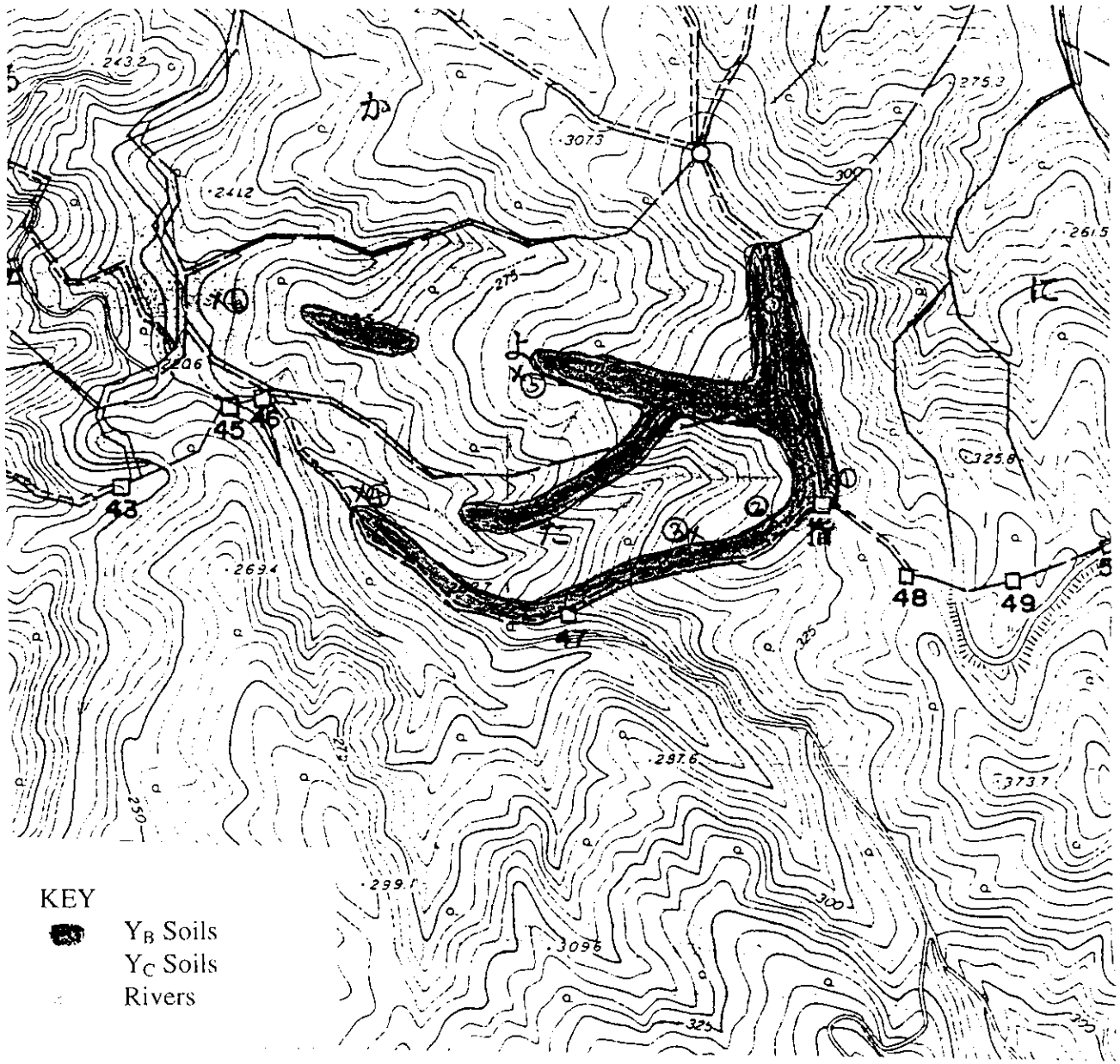


Soil Profile - Yona 6



Map 3. Soil distribution at Yona, study site

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5. COMMENTS AND SUGGESTIONS

The experiments carried out in the were very relevant to our present and future research in our countries. However, I suggest more replication of soil samples for physical and chemical analysis. High replication ensures security should something go wrong with a sample and increases accuracy of the results obtained.

6. APPENDICES

Appendix 1. Classification of Forest Soils in Okinawa

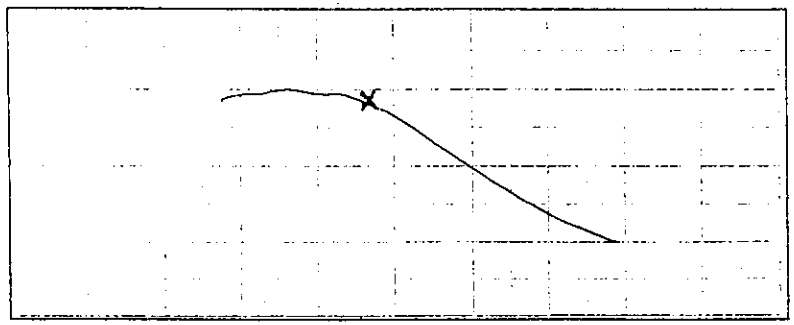
Soil Group	Subgroup	Type	Subtype	Abbreviation
Red and Yellow soils				RY
	Red Soils			R
		Dry red soil (loose granular structure type)		R_A
		Dry red soil (granular and nutty structure type)		R_B
		Weakly dried red soil		R_C
		Moderately moist red soil		R_D
			Moderately moist red soil (drier type)	$R_{D(d)}$
	Yellow soils			Y
		Dry yellow soils (loose granular structure type)		Y_A
		Dry yellow soils (granular and nutty structure type)		Y_B
		Weakly dried yellow soils		Y_C
		Moderately moist yellow soils		Y_D
		Slightly wetted yellow soils		Y_E
	Surface gleyed red yellow soils			gRY
		Strongly surface gleyed red and yellow soil		gRY_I
		Weakly surface gleyed red and yellow soil		gRY_{II}
		Strongly bleached red and yellow soil		gRY_{bI}
		Weakly bleached red and yellow soil		gRY_{bII}
Dark red soils				DR
	Eutric dark red soils			eDR
		Dry eutric dark red soil (loose granular type)		eDR_A
		Dry eutric dark red soil (granular & nutty structure type)		eDR_B
		Weakly dried eutric dark red soil		eDR_C
		Moderately moist eutric dark red soil		eDR_D
		Moderately moist eutric Dark red soil (drier subtype)		$eDR_{D(d)}$
		Slightly wetted dystric dark red soil		eDR_E
	Dystric dark red soils			dDR
		Dry dystric dark red soil (loose granular structure type)		dDR_A
		Dry dystric dark red soil (granular and nutty structure type)		dDR_B
		Weakly dried dystric dark red soil		dDR_C
		Moderately moist dystric dark red soil		dDR_D
		Moderately moist dystric dark red soil (drier subtype)		$dDR_{D(d)}$
		Slightly wetted dystric dark red soil		dDR_E
Gley soils				G
	Gley soil			G
		Gley soil		G
Immature soils				Im
	Immature soil			Im
		Immature soil		Im
	Eroded soil			Er
Eroded soil				Er

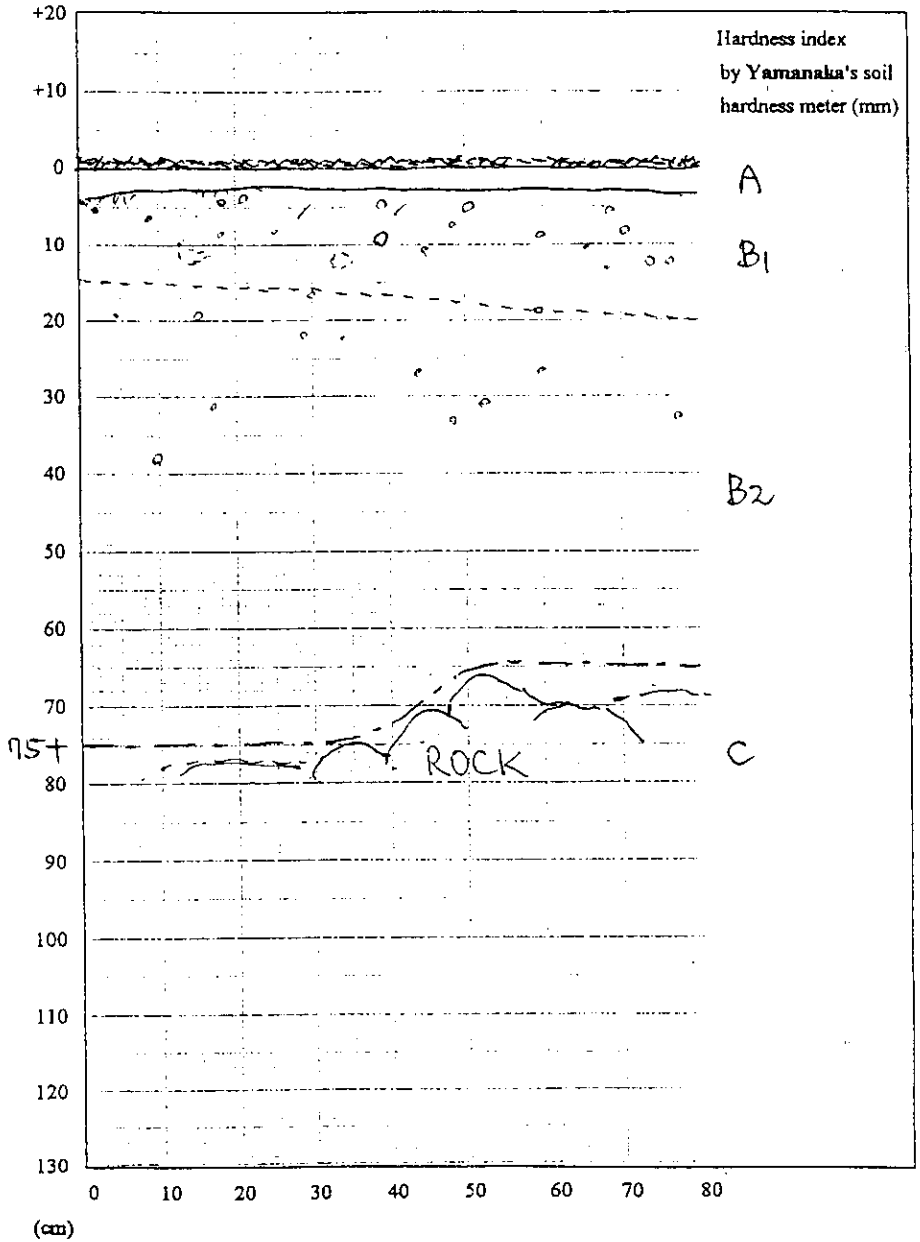
Field Notes for Forest Soil Survey

No. YONA-1
Name of soil type YB

1) Date of survey
1998, Sep. 23
2) Name of surveyor
JICA-96, (Nguyen & Phuong)
3) Weather
Cloudy & small rainy
4) Location of survey sites
top
5) Direction of slope
N42°W
6) Inclination angle of slope
32°
7) Elevation
340m
8) Type of soil deposit
Residual soil
9) Name of bedrock
Sandstone

Location map of survey site





YONA-1, YB

A_o horizon	Name of layer	Depth of layer average (min. - max.) example 20cm (10cm - 30cm)	Remarks
	L layer	1cm (0~1cm)	
	F layer	) 0.5 cm	
	H layer		

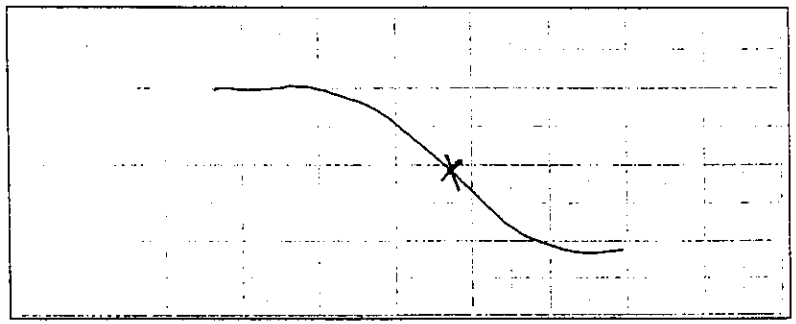
a) Name of horizon			A	B1	B2	C	
b) Depth of horizon average (min. - max.)			3.5cm (3~4cm)	17cm (14~20cm)	70cm (65~75cm)	75cm +	
c) Boundary			Abrupt	Gradual	Clear		
d) Color: color formulas color name			10YR4/3 dull yellowish brown	10YR5/6 yellowish brown	7.5YR5/8 bright brown		
e) Humus content			Moderate	Poor	Poor		
f) Gravel:	size		none	1cm	none		
	shape		none	angular	none		
	percentage		none	1%	none		
g) Texture			clay loam	clay loam	clay loam		
h) Structure			Granular, Moderate	Nutty, Weak	Massive, Weak		
i) Hardness			8 (9,12,8,5,8)	21 (21,18,22,24,21)	24 (22,23,24,26,26)		
j) Pores (porosity): size content			Small few	Fine few	none		
k) Moisture content			Moderate	Moderate	Moderate		
l) Eluviation and illuviation			none	none	none		
m) Micorrhiza and rhizomprph			none	none	none		
n) root	herby plant	size	none	none	none		
		content					
	woody plant	size	Medium	Medium, Fine	Fine		
		content	common	few few	few		
o) Remarks (Soil cylinder sampling)				(10~14cm)	(30~34cm)		

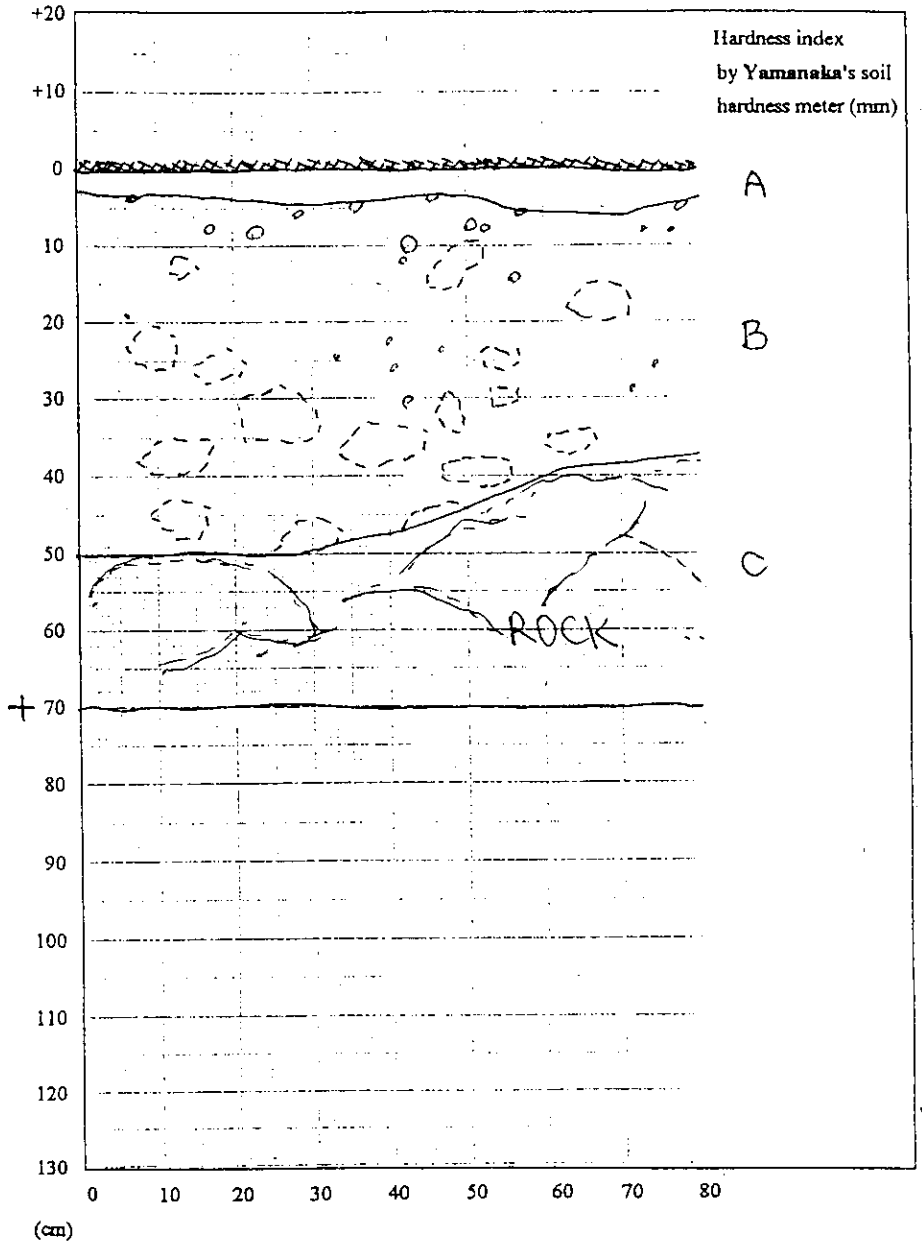
Field Notes for Forest Soil Survey

No. YONA-2
Name of soil type: YB

1) Date of survey
1998, Sep. 23
2) Name of surveyor
JICA-98, (Suhaimi & Crispin)
3) Weather
rainy
4) Location of survey sites
middle slope
5) Direction of slope
N63°E
6) Inclination angle of slope
34°
7) Elevation
325m
8) Type of soil deposit
Creeping soil
9) Name of bedrock
Sandstone

Location map of survey site





YONA-2, YB

A_o horizon	Name of layer	Depth of layer average (min. - max.) example 20cm (10cm - 30cm)	Remarks
	L layer	1cm (0~1cm)	
	F layer	) 0.5 cm	
	H layer		

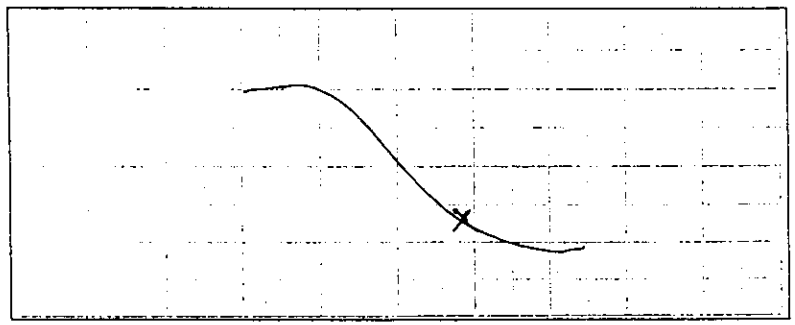
			A	B	C		
a) Name of horizon							
b) Depth of horizon average (min. - max.)			4.5cm (3~6cm)	43cm (36~50cm)	70cm+		
c) Boundary			Abrupt	Abrupt			
d) Color: color formulas color name			7.5YR3/2 brownish black	10YR5/6 yellowish brown			
e) Humus content			Moderate	Poor			
f) Gravel:	size		none	5cm			
	shape		none	angular			
	percentage		none	35%			
g) Texture			Clay loam	Clay loam			
h) Structure			Granular, Moderate	Nutty, Weak			
i) Hardness			12 (14,12,10,11,11)	17 (16,19,17,17,19)			
j) Pores (porosity): size content			Trine few	Medium, Small few few			
k) Moisture content			Moderate	Moderate			
l) Eluviation and illuviation			none	none			
m) Micorrhiza and rhizomprph			none	none			
n) root	herby plant	size content	none	none			
	woody plant	size content	Medium, Fine few Common	Coarse, Medium, Fine few few few			
o) Remarks (Soil Cylinder sampling)							

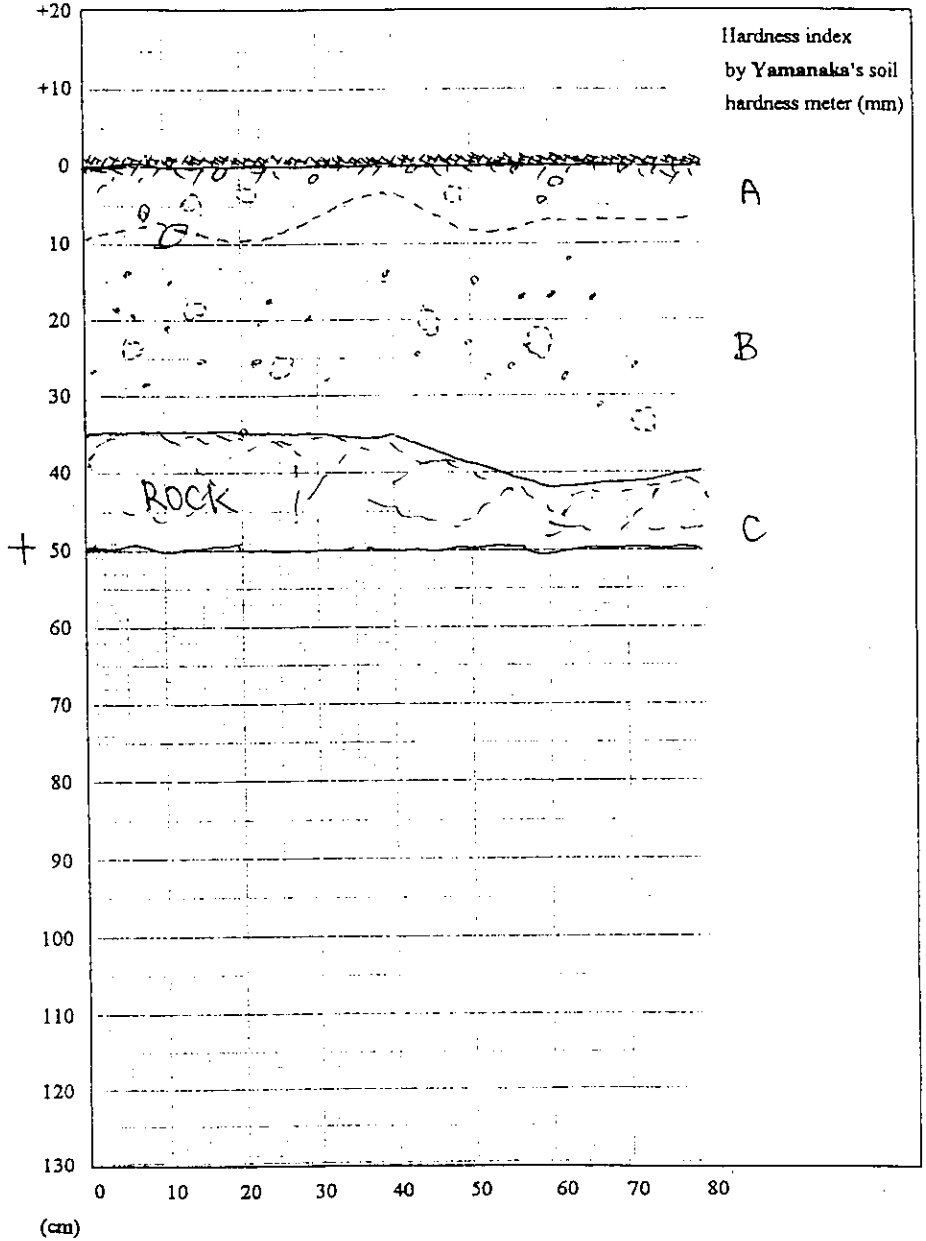
Field Notes for Forest Soil Survey

No. YONA-3
Name of soil type Yc

1) Date of survey
1998, Sep. 24
2) Name of surveyor
JICA-98, (Jacinto & Liw)
3) Weather
Cloudy
4) Location of survey sites
lower slope
5) Direction of slope
N 8 W
6) Inclination angle of slope
20°
7) Elevation
310 m
8) Type of soil deposit
Creeping soil
9) Name of bedrock
Sandstone

Location map of survey site





YONA-3, Yc

A_o horizon	Name of layer	Depth of layer average (min. - max.) example 20cm (10cm - 30cm)	Remarks
	L layer	1cm (0~1cm)	
	F layer	) 0.3 cm	
	H layer		

			A	B	C		
a) Name of horizon							
b) Depth of horizon average (min. - max.)			6.5cm (3~10cm)	38.5cm (35~42cm)	50cm +		
c) Boundary			Gradual	Abrupt			
d) Color: color formulas / color name			7.5YR4/3 brown	10YR5/8 yellowish brown			
e) Humus content			Moderate	Poor			
f) Gravel:	size		1cm	1~3cm			
	shape		angular	angular			
	percentage		1%	7%			
g) Texture			Clay	Clay loam			
h) Structure			Nutty, Moderate	Blocky, Weak			
i) Hardness			9 (8,9,12,6,12)	19 (20,19,18,20,18)			
j) Pores (porosity): size / content			Small, Fine few few	Medium, Small, Fine few few few			
k) Moisture content			Moderate	Moderate			
l) Eluviation and illuviation			none	none			
m) Micorrhiza and rhizomprph			none	none			
n) root	herby plant	size	Fine	none			
		content	few				
	woody plant	size	Coarse, Medium, Fine	Fine			
		content	few few Common	Common			
o) Remarks (Soil cylinder sampling)			(0~4cm)	B-Upper (20~24cm) B-Lower (45~49cm)			

Appendix 3. Tree Species Sociability

Plot No. 1 **Location: Yona** **Size:** 10x10 m (**radius:** 5.64 m)

Layer		**height (m)**	**% Cover**
I	Trees	9 to 10	95
II	Lower trees	6 to 9	40
III	Shrub	1 to 6	40
IV	Herb	< 1	15

No.	Layer	Sociability	Scientific Name
1	I	5.4	Castanopsis diffusa v. Steenis
2		+	Schima wallichii Korthals spp. liukiuensis Bloem
3		+	Cinnamomum doederleinii Engl.
4		+	Elaeocarpus japonicus S. et Z
5	II	3.1	Elaeocarpus japonicus S. et Z
6		2.1	Daphniphyllum glaucescens Bl.spp. teijsmanii Huang
7		+	Schima wallichii Korthals spp. liukiuensis Bloem
8		+	Rhaphiolepis indica Lindl. var. insularis Hatusima
9		+	Ilex liukiuensis Loesn
10		+	Ternstroemia japonica Thunb
11		+	Castanopsis sieboldii Hatusima
12		+	Myrsine seguinii Leveille
13		+	Dendropanax trifidus Mak.
14		+	Rhododentron tashiroi Maxim.
15		+	Persea thunbergii Kostern
16	III	2.2	Ardisia quinquegona Bl.
17		2.2	Myrsine seguinii Leveille
18		2.2	Neolitsea aciculata Koidz
19		1.2	Rhododenron tashiroi Maxim
20		1.2	Pleioblastus linearis Nakai
21		+.2	Castanopsis sieboldii Hatusima
22		+	Ilex integra Thunb
23		+	Ternstroemia japonica Thunb
24		+	Terenna gracilipes (Hayata) Ohwi
25		+	Randia canthiodes Champion
26		+	Cinnamomum doederleinii Engl.
27		+	Rhaphiolepis indica Lindl. var. insularis Hatusima
28		+	Ilex liukiuensis Loesn
29		+	Distylium rasemosum S. et Z.

Plot No. 1 **Sociability Continued**

No.	Layer	C.S	Scientific Name
30	III	+	Syzygium buxifolium Hook & Arn.
31		+	Tricalysia dubia Ohwi
32		+	Elaeocarpus japonicus S. et Z
33		+	Ilex maximowicziana Loesn. var. mutchagara Hatusima
34		+	Psychotria rubra poiret
35	IV	1.3	Alpinia intermedia Gagnepain
36		1.2	Psychotria serpens Linnaeus
37		1.2	Lindsaea chienii Ching
38		1.2	Castanopsis sieboldii Hatusima
39		+.2	Daphniphyllum glaucescens Bl.spp. teijsmanii Huang
40		+	Elaeocarpus japonicus S. et Z
41		+	Syzygium buxifolium Hook & Arn.
42		+	Myrsine seguinii Leveille
43		+	Naelitsea aciculata Koidz
44		+	Persea thunbergii Kosterm
45		+	Rhus succedanea Linnaeus
46		+	Osmanthus marginatus Hemsl.
47		+	Styrax japonicus S. & Z.
48		+	Tutcheria virgata Nakai
49		+	Symplocos glauca Koidz.
50		+	Alsophila podophylla Hook
51		+	Mussaenda parviflora Miquel
52		+	Schima wallichii Korthals spp. liukiuensis Bloem
53		+	Smilax nervo -marginata Hay
54		+	Damnacanthus biflorus Masumune
55		+	Antidesma japonica S. & Z.
56		+	Laphatherum gracile Brongn
57		+	Glochidion acuminatum Muell. Arg.
58		+	Meriosma squamulosa Hance

Plot No. 2. **Location: Yona** **Size:** 10 x10 m (**radius:**5.64 m)

Layers:		**Height(m)**	**% cover**
I	Tree	10-12	95
II	Lower tree	7 - 10	40
III	Shrub	1 - 7	20
IV	Herb	< 1	30

No	Layer	C.S	Scientific Name	Family
1	I	5.3	Castanopsis sieboldii Hatusima	Fagaceae
2		2.1	Persea thunbergii Kosterm	Lauraceae
3		2.1	Schima wallichii Korthal	Theraceae
4		+	Ilex warburgii Loesn	Aguifoliaceae
5		+	Quercus miyagii Koidz	Fagaceae
6	II	3.2	Distidium rasemosum S.et Z	Hamameridaceae
7		2.1	Ilex goshiensis Hayata	guifoliaceae
8		2.1	Schima wallichii Korthal	Theraceae
9		+	Ilex warburgii Loesn	Aguifoliaceae
10		+	Dendropanax trifidus Mak	Araliaceae
11		+	Scheflera octophylla Harms	Araliaceae
12		+	Gardenia jasminoides Ellis f. Mak	Rubiaceae
13		+	Meriosma squamulosa Hance	Sabiaceae
14		+	Tutcheria virgata Nakai	Theraceae
15	III	2.2	Distidium rasemosum S.et Z	Hamameridaceae
16		2.1	Myrsine seguinii Leveille	Myrsinaceae
17		+	Ilex warburgii Loesn	Aguifoliaceae
18		+	Ilex ryukyuensis Loens	Aguifoliaceae
19		+	Ilex goshiensis Hayata	Aguifoliaceae
20		+	Elaeocarpus japonicus S. et Z	Elaeocarpaceae
21		+	Rhododendro tashiroi Maxim	Ericaceae
22		+	Antidesma japonicum S. & Z	Euphorbiaceae
23		+	Castanopsis sieboldii Hatusima	Fagaceae
24		+	Neolitsea aciculata Koidz	Lauraceae
25		+	Ardisia quinquegona Bl	Myrsinaceae
26		+	Syzygium buxifolium Hook & Arn	Myrtaceae
27		+	Randia canthiodes Champion	Rubiaceae
28		+	Psychotria rubra Poiret	Rubiaceae
29		+	Lasianthus fordii Hance	Rubiaceae
30		+	Meriosma squamulosa Hance	Sabiaceae

Plot No. 2 **Sociability continued**

No.	Layer	C.S	Scientific name	Family
31		+	Tutcheria virgata Nakai	Theraceae
32	IV	3.3	Tutcheria virgata Nakai	Theraceae
33		2	Litsea acuminata Kurata	Lauraceae
34		1.2	Ardisia quinquegona Bl	Myrsinaceae
35		+	Cinamomum japonium Sieb	Lauraceae
36		+	Lassianthus fordii Hance	Rubiaceae
37		+	Alsophila podophylla Hook	Cyatheaceae
38		+	Psychotria rubra Poiret	Rubiaceae
39		+	Styrax japonicus S. & Z	Styraceae
40		+	Daphniphyllum glaucescens Bl. ssp. teijsmannii .H	Euphorbiaceae
41		+	Neolitsea aciculata Koidz.	Lauraceae
42		+	Elaeocarpus japonicus S. et Z.	Elaeocarpaceae
43		+	Castanopsis sieboldii Hatusima	Fagaceae
44		+	Elaeocarpus decipiens Hemsl.	Elaeocarpaceae
45		+	Dendropanax trifidus Mak.	Araliaceae
46		+	Antidesma japonicum S. & Z.	Euphorbiaceae
47		+	Symplocos okinawensis Matsum.	Symplocaceae
48		+	Symplocos glauca Koidz.	Symplocaceae
49		+	Glochidion acuminatum Muell. Arg.	Euphorbiaceae
50		+	Lindsaea chienii Ching	Pteridaceae
51		+	Smilax bracteata Presl.	Liliaceae
52		+	Viburnum japonicum Sprengel	Caprifoliaceae
53		+	Persea thunberrgii Kosterm.	Lauraceae
54		+	Syzygium buxifolium hook. & Arn.	Myrtaceae
55		+	Arachiniodes diorphophylla Ching	Aspidiaceae
56		+	Rhus succedanea Linnaeus	Anacardiaceae
57		+	Psychotria serpens Linnaeus.	Rubiaceae
58		+	Thelypteris angustifrons Ching	Aspidiaceae
59		+	Randia canthioides Champion	Rubiaceae
60		+	Ardisia crenata Sims	Myrsinaceae
61		+	Alpinia intermedia Gagnepain	Zingiberaceae

Plot No. 3 **Location: Yona** **Size:** 10x10m(**Radius:** 5.64m)

Layer	**Height (m)**	**% Cover**
I - Tree	13 - 14	97
II - Lower Tree	7- 9	20
III - Shrub	1 - 6	10
IV - Herb	< 1	15

Layer	**C.S**	**Scientific Name**	**Family**
I	5.3	Styraxjaponicus S. & Z	Styracaceae
	1.2	Ficus sarmentosa	
II	+	Schima wallichi	Theaceae
	1.2	Wendlandia formosana Cowan	Rubiaceae
	1.2	Turpinia ternata Nakai	Staphyleaceae
	1.2	Elaeocarpus japonicus S. et. Z	Elaeocarpaceae
III	1.3	Alsophila podophylla Hook	Cyatheaceae
	+	Turpinia ternata Nakai	Staphyleaceae
	+	Ardisia quinquegona Bl.	Myrsinaceae
	+	Psychotria sepens Linnaeus	Rubiaceae
IV	2.2	Balbitis subcordata	
	+.2	Diplazium donianum	
	+.2	Blechnum orienntale L.	Blechnaceae
	+.2	Alpinia intermedia Gagnepain	Zingiberaceae
	+.2	Angiopteris lygodifolia	
	+	Ctenitis subglandulosa Ching	Aspidiaceae
	+	Lasianthus fordii Hance	Rubiaceae
	+	Psychotria rubra Poiret	Rubiaceae
	+	Dryopteris hasseltii	
	+	Ardisia quinquegona Bl.	Myrsinaceae
	+	Lasianthus plagiophyllus Ilance	Rubiaceae
	+	Calanthe lyroglossa	
	+	Ficus benguetensis Merr	Moraceae
	+	Selaginella doederleinii Ilieronymus	Selaginellaceae
	+	Schefflera octophylla Harms	Araliaceae
	+	Mallotus japonicus Muell. -Arg	Euphorbiaceae
	+	Oplismenus compositus Beaub. Var. patens Ohwi	Gramineae
	+	Neolitsea aciculata Koidz	Lauraceae
	+	Castanopsis sieboldi Hatusima	Fagaceae
	+	Lindsaea orbiculata Mett var. comixta Kramer	Pteridaceae
	+	Tutcheria virgata Nakai	Theaceae
	+	Dendroppanax trifidus Mak.	Araliaceae
	+	Kadsura japonica Dunal	Magnoliaceae

Plot No. 4 **Location: Yona** **Size:** 100m^2 (**Radius**:5.64 m)

Layer	**Height (m)**	**% Cover**
I - Tree	12 - 13	95 %
II - Lower Tree	7 - 9	25 %
III - Shrub	1 - 5	20 %
IV - Herb	< 1	15 %

Layer	(C.S)	No.	Scientific Name	Family
I	4.3	76	Castanopsis sieboldi Hatusima	Fagaceae
	1.1	69	Schima wallichi	Theaceae
II	+	2	Syzygium buxifolium Hook. & Arn.	Myrtaceae
	+	202	Myrsine seguinii Leveille	Myrsinaceae
	+	125	Meriosma sguamulosa Hance	Sabiaceae
	+	64	Rhaphiolepis indica Lindl. Var. liukiuensis Kitam	Rosaceae
	+	69	Schima wallichii Korthals ssp. Liukiuensis Bloem.	Theaceae
III	+	184	Randiacanthioides Champion	Rubiaceae
	+	71	Ficus erecta Thunb	Moraceae
	+	169	Rhododendron tashiroi Maxim.	Ericaceae
	+	235	Euonymus tashiroi Maxim	Celastraceae
	1.3	19	Psychotria rubra Poiret	Rubiaceae
	+	194	Ardisia quinquegona Bl.	Myrsinaceae
	+	2	Syzygium buxifolium Hook. & Arn.	Myrtaceae
	+	202	Myrsine seguinii Leveille	Myrsinaceae
	+	74	Distylium rasemosum S. et Z.	Hamameridaceae
	+	35	Terenna gracilipes (Hayata) Ohwi	Rubiaceae
	+	214	Ilex goshiensis Hayata	Aguifoliaceae
	+	163		
	+	90	Elaeocarpus japonica S. et Z.	Elaeocarpaceae
	+	180	Chinnamomum doederleinii Engl.	Lauraceae
	+	230	Antidesma japonicum S. & Z.	Euphorbiaceae
	+	67	Coptosapeita diffusa v. Steenis	Rubiaceae
IV	1.2	194	Ardisia quinquegona Bl.	Myrsinaceae
	+	207	Lasianthus fordii Hance	Rubiaceae
	1.2	202	Myrsine seguinii Leveille	Myrsinaceae
	+	76	Castanopsis sieboldi Hatusima	Fagaceae
	+	56	Tutcheria virgata Nakai	Theaceae
	1.2	13	Alpinia intermedia Gagnepain	Zingiberaceae
	+	2	Syzygium buxifolium Hook. & Arn.	Myrtaceae
	+	184	Randiacanthioides Champion	Rubiaceae
	+	71	Ficus erecta Thunb	Moraceae
	+	201	Persea thunbergii Kosterm	Lauraceae
	+	230	Antidesma japonicum S. & Z.	Euphorbiaceae
	+	235	Euonymus tashiroi Maxim	Celastraceae

Plot No. 5 **Location**: Yona **Plot size:** 10 x 10 m (**radius** : 5.64 m)

Layer	Tree Height (m)	% Cover
I Tree	> 10	90
II Lower Tree	7 - 10m	25
III Shrub	1 - 7	30
IV Herb	< 1	5

No.	Layer	C.S	Scientific Name	Spp. Code
1	I	4.5	Castanopsis sieboldii Hatusima	76
2		2.1	Schima wallichii Korthals ssp. liukiuensis Bloem	69
3	II	+	Elaeocarpus japonicus S. et Z.	90
4		+	Neolitsea sericea Koidzumi	191
5		+	Daphniphyllum glaucescens Bl. spp. teijsmannii Huang	51
6		+	Randia canthioides Champion	184
7		+	Cinnamomum doederleinii Engl.	180
8	III	1.2	Distylium rasemosum S. et Z.	74
9		1.2	Schefflera octophylla Harms	27
10		1.2	Randia canthioides Champion	184
11		+	Ternstroemia japonica Thunb	120
12		+	Camellia sasanqua Thunb	176
13		+	Tricalysia dubia Ohwi	193
14		+	Daphniphyllum glaucescens Bl. spp. teijsmannii Huang	51
15		+	Osmanthus marginatus Hemsl.	162
16		+	Ilex goshiensis Hayata	214
17		+	Gardenia jasminoides Ellis f. grandiflora Mak.	102
18		+	Eurya japonicum Thunb	55
19		+	Pogonantherum crinitum Kunth	75
20		+	syzygium buxifolium	2
21		+	Diospyros morrisiana Hance	211
22		+	Ardisia quinquegona Bl.	194
23		+	Meriosma squamulosa Hance	125
24		+	Dendropanax trifidus Mak.	79
25		+	Myrsine seguinii Leveille	202
26		+	Persea thurnbergii Korstern	201
27		+	Antidesma japonicum S. & Z.	230
28		+	Rhododendron tashiroi Maxim.	169
29	IV	1.1	Distylium rasemosum S. et Z.	74
30		+	Ilex goshiensis Hayata	214
31		+	Ilex maximowicziana Loesn. Var. mutchagara Hatusima	124

Plot No. 5. Sociability Continued

No.	Layer	C.S.	Scientific Name	Spp. Code
32	IV	+	Tricalysia dubia Ohwi	193
33		+	Randia canthioides Champion	184
34		+	Elaeocarpus japonicus S. et Z.	90
35		+	Meriosma squamulosa Hance	125
36		+	Myrsine seguinii Leveille	202
37		+	Ardisia quinquegona Bl.	194
38		+	Persea thurnbergii Korstern	201
39		+	Neolitsea sericea Koidzumi	191
40		+	Daphniphyllum glaucescens Bl. spp. teijsmannii Huang	51
41		+	Ilex goshiensis Hayata	214
42		+	Glochidion acuminatum Muell. -Arg.	222
43		+	Microtropis japonica Hall. f.	122
44		+	Smilax bracteata Presl	175
45		+	syzygium buxifolium	2
46		+	Smilax nervo-marginata Hay	171
47		+	Gardenia jasminoides Ellis f. grandiflora Mak.	102
48		+	Ardisia crenata Sims	109
49		+	Schima wallichii Korthals ssp. liukiuensis Bloem	69
50		+	Dendropanax trifidus Mak.	79
51		+	Symplocos glauca Koidz.	115
52		+	Castanopsis sieboldii Hatusima	76
53		+	Symplocos prunifolia S. & Z.	103
54		+	Elaeocarpus decipiens Hemsl	61
55		+	Trachelospermum asiaticum Nak. Var. brevisepalum T. Tsiang	165
56		+	Alpinia intermedia Gagnepain	13
57		+	Pleioblastus linearis Nakai	141
58		+	Pleioblastus linearis Nakai	154
59		+	Psychotria serpens Linnaeus	190
60		+	Antidesma japonicum S. & Z.	230
61		+	Blechnum orientale L.	54

Plot No. 6. **Location : Yona** **Plot size**: 10x10 m (**radius**: 5.64 m)

Layers		Height(m)	% cover
I	Trees	10 over	95
II	Lower tree	6 - 10	30
III	Shrub	1 - 6	30
IV	Herb	< 1	10

No.	Layers	C.S	Scientific name	Family
1	I	5.5	Castanopsis sieboldii Hatusima	Fagaceae
2		+	spp	Unknown
3	II	+	Daphniphyllum glaucescens Bl.spp.teijsmannii Huang	Euphorbiaceae
4		+	Cinnamomum japonicum Sieb	Lauraceae
5		+	Cinnamomum doederleinii Engl.	Lauraceae
6		+	Symplocos lucida S. & Z	Symplocaceae
7		+	Symplocos glauca Koidz	Symplocaceae
8		+	Symplocos prunifolia S. & Z	Symplocaceae
9		+	Ternstromia japonica Thunb	Theaceae
10		+	Schima walichii Korthal.spp liukiuensis Bloem	Theaceae
11		+	Miyamashirobai	Unknown
12	III	.2.2	Syzygium buxifolium Hook & Arn	Myrtaceae
13		1.1	Dendronapax trifidus Mak	Araliaceae
14		+	Ilex goshiensis Hayata	Aguifoliaceae
15		+	Ilex maximowicziana Loesn.var. mutchagara Hatusima	Aguifoliaceae
16		+	Elaeocarpus japonicus S. & Z	Elaeocarpaceae
17		+	Vaccinium wrighii A. Gray	Ericaceae
18		+	Rhododendro tashiroi Maxim	Ericaceae
19		+	Antidesma japonicum S. & Z	Euphorbiaceae
20		+	Daphniphyllum glaucescens Bl.spp.teijsmannii Huang	Euphorbiaceae
21		+	Persea thunbergii Kostern	Lauraceae
22		+	Cinnamomum doederleinii Engl.	Lauraceae
23		+	Mucuna macrocarpa Wall	Leguminaceae
24		+	Myrsine seguinii Leveille	Myrsinaceae
25		+	Podocarpus macrophyllus D.Don	Podocarpaceae
26		+	Randia canthioides Champion	Rubiaceae
27		+	Camellia sasanqua Thunb	Theaceae
28		+	Tutcheria virgata Nakai	Theaceae
29		+	Myamashirobai	Unknown
30	IV	1.2	Rhododendro tashiroi Maxim	Ericaceae
31		1.2	Meriosma squamulosa Hance	Sabiaceae
32		+	Dendronapax trifidus Mak	Araliaceae
33		+	Viburrnum japonicum Sprengel	Caprifoliaceae
34		+	Elaeocarpus japonicus S. & Z	Elaeocarpaceae
35		+	Antidesma japonicum S. & Z	Euphorbiaceae
36		+	Castanopsis sieboldii Hatusima	Fagaceae
37		+	Lophatherum gracile Brongn	Gramineae
38		+	Persea thunbergii Kostern	Lauraceae
39		+	Cinnamomum doederleinii Engl.	Lauraceae

Appendix 4. Tree Growth Assesment

a) Diameter at Breast Height (DBH) and Height (TH)

Plot No: 1 **Size:** 10x10 m

Surveyor: Chrispin & Suhaimi **Date**: 1998/Sept./23

No.	Scientific Name	Code. No	DBH (cm)	TH (m)
1.	Schima wallichii korthals spp liuliuensis Bloem	12	19.6	10
2.	Castanopsis sieboldii Hatusima	10	24.4	9
3.	Elaeocarpus japonicus S. et Z.	58	8.1	7
4.	Cinnamomum doederleinii Engl.	41	5.1	6
5.	Cinnamomum doederleinii Engl.	41	3.9	4
6.	Dendropanax trifidus Mak.	77	4.6	5
7.	Randia canthioides Champion	143	3.1	4
8.	Elaeocarpus japonicus S. et Z.	58	3.7	4
9.	Elaeocarpus japonicus S. et Z.	58	5.7	6
10.	Ilex liukiuensis Loesn.	50	10.3	7
11.	Ilex liukiuensis Loesn.	50	4.0	5
12.	Myrsine seguinii Leveille	62	6.8	6
13.	Castanopsis sieboldii Hatusima	10	12.1	8
14.	Schima wallichii korthals spp liuliuensis Bloem	12	15.6	9
15.	Castanopsis sieboldii Hatusima	10	20.2	10
16.	Persea thunbergii Kosterm	30	6.2	6
17.	Dendropanax trifidus Mak.	77	10.6	7
18.	Neolitsea aciculata Koidz.	45	4.0	4
19.	Daphniphyllum glaucescens Bl.ssp.teijsmannii Huang	47	18.2	7
20.	Ternstroemia japonica Thunb	17	3.5	4
21.	Ternstroemia japonica Thunb	17	5.3	5
22.	Castanopsis sieboldii Hatusima	10	22.5	10
23.	Cleyera japonica Thunb	61	17	9
24.	Elaeocarpus japonicus S. et Z.	58	13.8	9
25.	Cinnamomum doederleinii Engl.	41	18.9	9
26.	Myrsine seguinii Leveille	62	7.7	6
27.	Diospyros morrisiana Hance	64	8	7

Plot No: 1 DBT and TH continued

28.	Ternstroemia japonica Thunb	17	4	5
29.	Ternstroemia japonica Thunb	17	4.5	5
30.	Elaeocarpus japonicus S. et Z.	58	5.2	5
31.	Castanopsis sieboldii Hatusima	10	16.4	10
32.	Castanopsis sieboldii Hatusima	10	18.2	10
33.	Castanopsis sieboldii Hatusima	10	12.8	10
34.	Tutcheria virgata Nakai	78	5.2	5
35.	Daphniphyllum glaucescens Bl.ssp.teijsmannii Huang	47	15.2	7
36.	Distylium rasemosum S. et Z.	13	4.0	4
37.	Castanopsis sieboldii Hatusima	10	25.5	9
38.	Ternstroemia japonica Thunb	17	5.5	6
39.	Ternstroemia japonica Thunb	17	4.6	5
40.	Schima wallichii korthals spp liuliuensis Bloem	12	5.9	6
41.	Elaeocarpus japonicus S. et Z.	58	10.4	7
39.	Randia canthioides Champion	143	4.0	4
40.	Dendropanax trifidus Mak.	77	4.2	5
41.	Myrsine seguinii Leveille	62	9.2	6
42.	Castanopsis sieboldii Hatusima	10	30.9	11
43.	Distylium rasemosum S. et Z.	13	4.5	5
44.	Rhaphiolepis indica Lindl. Var. insularis Hatusima	15	12.7	8
45.	Castanopsis sieboldii Hatusima	10	45.2	11
46.	Ternstroemia japonica Thunb	17	6.2	5
47.	Castanopsis sieboldii Hatusima	10	23.0	9
48.	Ilex liukiuensis Loesn.	50	7.8	7
49.	Ternstroemia japonica Thunb	17	3.8	4
50.	Microtropis japonica Hall.f.	134	7.8	6
51.	Cinnamomum camphora Presl	14	6.0	7
52.	Ternstroemia japonica Thunb	17	4.5	3
53.	Ilex liukiuensis Loesn.	50	15.4	8
54.	Myrsine seguinii Leveille	62	7.2	5
55.	Myrsine seguinii Leveille	62	7.6	6

Plot No. 2 **Size:** 10 x 10 m

Surveyor: Jacinta & Liu **Date:** 1998/Sept/23

No.	Scientific Name	Spp. Code.	DBH (cm)	TH (m)
1	Meliosma oldhamii Maxim. Var. rhoifolia Hatusima	55	6.3	6.0
2	Ilex goshiensis Hayata	48	5.4	5.0
3	Scheffera octophylla Harms	75	6.3	7.0
4	Meriosma squamulosa Hance	57	14.7	8.0
5	Tutcheria virgata Nakai	78	3.4	4.0
6	Ilex goshiensis Hayata	48	3.4	6.0
7	Schima wallichii Korthals Spp. Liuliuensis Bloem	12	6.1	6.0
8	Persea thunbergii Korstern	30	18.1	10.0
9	Schima wallichii Korthals Spp. Liuliuensis Bloem	12	24.0	10.0
10	Rhododentron tashiroi Maxim	107	3.0	3.0
11	Eurya japonica Thunb	106	3.9	5.0
12	Ilex liukiuensis Loesn	50	18.0	9.0
13	Pscychotria rubra poir	78	7.4	6.0
14	Castanopsis sieboldii Hatusima	10	22.4	11.0
15	Scheffera octophylla Harms	75	20.2	8.0
16	Ilex liukiuensis Loesn	50	3.3	5.0
17	Psychotria rubra poir	142	3.4	2.0
18	Psychotria rubra poir	142	3.6	4.0
19	Castanopsis sieboldii Hatusima	10	27.6	13.0
20	Castanopsis sieboldii Hatusima	10	28.2	12.0
21	Distylium rasemosum S. et Z.	13	5.8	7.0
22	Distylium rasemosum S. et Z.	13	6.5	6.0
23	Ilex liukiuensis Loesn	50	4.0	5.0
24	Persea thunbergii Korstern	30	19.6	11.0

Plot No. 2 . DBH and TH Continued

No.	Scientific Name	Spp. Code.	DBH (cm)	TH (m)
25	Distylium rasemosum S. et Z.	13	10.9	8.0
26	Distylium rasemosum S. et Z.	13	3.4	8.0
27	Ilex goshiensis Hayata	48	12.6	8.0
28	Schima wallichii Korthals Spp. Liuliuensis Bloem	12	16.6	10.0
29	Elaeocarpus japonicaus S. et Z.	58	4.7	4.0
30	Meriosma squamulosa Hance	57	4.6	4.0
31	Gardenia jasminoides Ellis f. grandiflora Mak.	118	7.3	7.0
32	Symphcos Okinawensis matsum	113	5.6	5.0
33	Castanopsis sieboldii Hatusima	10	28.0	12.0
34	Symphcos Okinawensis matsum	113	4.4	4.0
35	Tutcheria virgata Nakai	78	7.5	4.0
36	Rhododentron tashiroi Maxim.	107	8.0	4.0
37	Distylium rasemosum S. et Z.	13	6.0	5.0
38	Ilex goshiensis Hayata	48	3.8	3.0
39	Distylium rasemosum S. et Z.	13	7.2	4.0
40	Ilex liukiuensis Loesn	50	3.7	3.0
41	Meriosma squamulosa Hance	57	6.4	4.0
42	Castanopsis sieboldii Hatusima	10	64.0	15.0
43	Distylium rasemosum S. et Z.	13	5.2	3.0
44	Symplocos microcalyx Hay	112	6.1	5.0
45	Distylium rasemosum S. et Z.	13	3.8	4.0
46	Ilex goshiensis Hayata	48	24.5	9.0
47	Schima wallichii Korthals Spp. Liuliuensis Bloem	12	4.7	5.0
48	Schima wallichii Korthals Spp. Liuliuensis Bloem	12	9.2	7.0

Plot No. 3. **Size**: 10 x 10 m
Surveyor: Phoungh & Nguyen **Date**: 1998/Sept/23

No.	Family	Scientific Name	DBH (cm)	TH (m)
1	Araliaceae	Dendropanax trifidus Mak	7.0	7.0
2	Araliaceae	Dendropanax trifidus Mak	4.4	5.0
3	Araliaceae	Dendropanax trifidus Mak	5.9	8.0
4	Araliaceae	Dendropanax trifidus Mak	8.8	7.0
7	Gramineae	Bambusa glaucescens Sieb.ex Merr	14.9	13.0
8	Guttifereae	Garcinia subelliptica Merr	20.5	14.0
9	Guttifereae	Garcinia subelliptica Merr	20.8	14.0
10	Guttifereae	Garcinia subelliptica Merr	10.2	10.0
11	Podocarpaceae	Podocarpus macrophyllus D.Don	5.5	8.0
12	Podocarpaceae	Podocarpus macrophyllus D.Don	8.8	9.0
13	Podocarpaceae	Podocarpus macrophyllus D.Don	6.4	8.0
14	Podocarpaceae	Podocarpus macrophyllus D.Don	7.3	7.0
15	Sterculiaceae	Firmiana simplex W.F. Wight	8.8	9.0

Plot No. : 4 **Size:** 10 x 10 m

Surveyor: Jacinta and Liu **Date**: 1998/Nov./*10*

No.	Scientific Name	DBH (cm)	(TH (m)
1	Meriosma squamulosa Hance	5.1	5
2	Neolitsea aciculata Koidz	3.2	5
3	Camellina japonia L.	4.9	4
4	Ternstroemia japonica Thunb	6.7	7
5	Schima wallichii korthals Spp. Liuliuensis Bloem	18.1	12
6	Schima wallichii korthals Spp. Liuliuensis Bloem	22.1	12
7	Castanopsis sieboldii Hatusima	17.5	12
8	Castanopsis sieboldii Hatusima	20.5	12
9	Ternstroemia japonica Thunb	5.7	6
10	Ternstroemia japonica Thunb	8.0	7
11	Meriosma squamulosa Hance	5.1	5
12	Tricalysia dubia Ohwi	3.3	4
13	Rhaphiolepis indica Lindl. var. Liukiuensis kitam	7.8	7
14	Syzgium buxifolium Hook & Arn.	4.2	5
15	Ternstroemia japonica Thunb	6.1	5
16	Meriosma squamulosa Hance	4.0	3
17	Castanopsis sieboldii Hatusima	49.6	13
18	Castanopsis sieboldii Hatusima	26.0	13
19	Neolitsea aciculata Koidz	5.3	6
20	Tricalysia dubia Ohwi	5.0	5
21	Myrisine seguinii leveille	6.8	6
22	Eurya japonica Thunb	3.7	5
23	Myrisine seguinii leveille	5.6	6
24	Schima wallichii korthals Spp. Liuliuensis Bloem	24.0	13
25	Distylium rasemosum S. et. Z	6.2	6
26	Meriosma squamulosa Hance	6.0	5
27	Distylium rasemosum S. et. Z	4.8	5
28	Syzgium buxifolium Hook & Arn.	6.6	7
29	Myrisine seguinii leveille	5.1	5
30	Myrisine seguinii leveille	4.9	5
31	Distylium rasemosum S. et. Z	3.3	6
32	Rhaphiolepis indica Lindl. var. Liukiuensis kitam	6.8	7
33	Distylium rasemosum S. et. Z	4.1	5
34	Castanopsis sieboldii Hatusima	19.0	11
35	Schima wallichii korthals Spp. Liuliuensis Bloem	13.9	11
36	Schima wallichii korthals Spp. Liuliuensis Bloem	10.9	10
37	Castanopsis sieboldii Hatusima	14.5	12
38	Castanopsis sieboldii Hatusima	14.3	12
39	Ternstroemia japonica Thunb	4.5	6

Plot No. 5 **Size** : 10 x 10 m

Surveyor: Phoungh & Nguyen **Date** : 1998/Nov.11.

No.	Family	Scientific Name	DBH (cm)	TH (m)
1	Lauraceae	Neolitseea sericea Koidzumi	5.7	7.0
2	Theaceae	Schima wallichii korthals spp. liuliuensis Bloem	7.9	7.0
3	Theaceae	Schima wallichii korthals spp. liuliuensis Bloem	10.8	10.0
4	Sabiaceae	Meriosma squamulosa Hance	4.4	5.0
5	Theaceae	Schima wallichii korthals spp. liuliuensis Bloem	12.5	15.0
6	Theaceae	Schima wallichii korthals spp. liuliuensis Bloem	19.2	15.0
7	Theaceae	Schima wallichii korthals spp.liuliuensis Bloem	19.7	15.0
8	Theaceae	Schima wallichii korthals spp.liuliuensis Bloem	16.9	14.0
9	Fagaceae	Castanopsis sieboldii Hatusima	24.2	15.0
10	Fagaceae	Castanopsis sieboldii Hatusima	15.9	10.0
11	Fagaceae	Castanopsis sieboldii Hatusima	25.8	15.0
12	Lauraceae	Neolitseea sericea Koidzumi	4.2	4.0
13	Anacardiaceae	Rhus succedanea Linnaeus	8.4	8.0
14	Lauraceae	Neolitseea sericea Koidzumi	4.0	5.0
15	Fagaceae	Castanopsis sieboldii Hatusima	16.3	15.0
16	Fagaceae	Castanopsis sieboldii Hatusima	14.6	15.0
17	Araliaceae	Dendropanax trifidus Mak.	4.4	5.0
18	Elaeocarpaceae	Elaeocarpus japonicus S. et Z.	6.7	6.0
19	Fagaceae	Castanopsis sieboldii Hatusima	14.7	13.0
20	Euphorbiaceae	Daphniphyllum glaucescens Bl. ssp.teijsmannii Huang	11.7	11.0
21	Euphorbiaceae	Daphniphyllum glaucescens Bl. ssp. teijsmannii Huang	9.1	6.0
22	Theaceae	Schima wallichii korthals spp. liuliuensis Bloem	19.2	14.0
23	Theaceae	Schima wallichii korthals spp. liuliuensis Bloem	26.2	15.0
24	Rubiaceae	Randia canthioides champion	5.1	4.0
25	Rubiaceae	Tricalysia dubia ohwi	3.0	3.0
26	Theaceae	Camellia sasanqua Thumb.	3.9	4.0
27	Elaeocarpaceae	Elaeocarpus japonicus S. et Z.	4.2	6.0
28	Lauraceae	Cinnamomum doederleinii Engl.	9.0	7.0
29	Theaceae	Ternstroemia japonica Thumb.	5.1	5.0
30	Fagaceae	Castanopsis sieboldii Hatusima	19.8	13.0
31	Aguifoliaceae	Ilex liukiuensis Loesn.	4.2	7.0

Plot No. 5 DBH and TH continued

No	Family	Scientific name	DBH (cm)	TH (m)
32	Aguifoliaceae	Ilex liukiuensis Loesn.	3.9	6.0
33	Lauraceae	Cinnamomum doederleinii Engl.	6.5	7.0
34	Theaceae	Schima wallichii korthals spp.liuliuensis Bloem	4.6	3.0
35	Theaceae	Schima wallichii korthals spp.liuliuensis Bloem	4.6	5.0
36	Fagaceae	Castanopsis sieboldii Hatusima	19.2	14.0
37	Theaceae	Schima wallichii korthals spp. liuliuensis Bloem	16.3	13.0
38	Theaceae	Schima wallichii korthals spp. liuliuensis Bloem	19.5	14.0
39	Theaceae	Schima wallichii korthals spp.liuliuensis Bloem	21.5	13.0
40	Fagaceae	Castanopsis sieboldii Hatusima	16.2	13.0
41	Elaeocarpaceae	Elaeocarpus japonicus S. et Z.	3.2	4.0
42	Fagaceae	Castanopsis sieboldii Hatusima	18.7	12
43	Aguifoliaceae	Ilex liukiuensis Loesn.	3.2	5
44	Myrsinaceae	Myrsine seguinii Leveille	3.3	5
45	Myrsinaceae	Myrsine seguinii Leveille	3.8	5
46	Hamameridaceae	Distylium rasemosum S. et Z.	3.7	4
47	Rubiaceae	Tricalysia dubia ohwi	3.2	3

Plot No. 6 **Size:** 10 x 10 m
Surveyor: Chrispin & Suhaimi **DATE:** 1998/Nov./11

No.	Scientific Name	Code. No.	DBH (cm)	TH (m)
1.	Symplocos lucida S. & Z.	73	10.9	8
2.	Daphniphyllum glaucescens Bl.ssp.teijsmannii Huang	47	6.1	5
3.	Castanopsis sieboldii Hatusima	10	10.8	10
4.	Castanopsis sieboldii Hatusima	10	16.6	11
5.	Castanopsis sieboldii Hatusima	10	16.7	11
6.	Ternstroemia japonica Thunb	17	8.0	8
7.	Ternstroemia japonica Thunb	17	7.5	7
8.	Daphniphyllum glaucescens Bl.ssp.teijsmannii Huang	47	13	8
9.	Tricalysia dubia Ohwi	71	5.4	7
10.	Daphniphyllum glaucescens Bl.ssp.teijsmannii Huang	47	11.7	9
11.	Daphniphyllum glaucescens Bl.ssp.teijsmannii Huang	47	7.6	6
12.	Schima wallichii korthals spp liuliuensis Bloem	12	10.1	11
13.	Schima wallichii korthals spp liuliuensis Bloem	12	15.8	13
14.	Cinnamomum doederleinii Engl.	41	6.9	9
15.	Ternstroemia japonica Thunb	17	8.1	7
16.	Dendropanax trifidus Mak.	106	4.1	5
17.	Daphniphyllum glaucescens Bl.ssp.teijsmannii Huang	47	3.3	4
18.	Castanopsis sieboldii Hatusima	10	19.4	14
19.	Daphniphyllum glaucescens Bl.ssp.teijsmannii Huang	47	5.1	4
20.	Cinnamomum doederleinii Engl.	41	8.8	10
21.	Tutcheria virgata Nakai	78	3.9	3
22.	Symplocos prunifolia S. & Z.	67	9.1	7
23.	Syzgium buxifolium Hook. & Arn	23	3.3	4
24.	Cinnamomum doederleinii Engl.	113	5.0	5
25.	Castanopsis sieboldii Hatusima	10	17.5	13
26.	Diospyros morrisiana Hance	58	4.2	4
27.	Cinnamomum doederleinii Engl.	41	5.1	6
28.	Syzgium buxifolium Hook. & Arn	23	5.2	7
29.	Elaeocarpus japonicus S. et Z.	62	3.4	5
30.	Castanopsis sieboldii Hatusima	10	11.1	11
31.	Daphniphyllum glaucescens Bl.ssp.teijsmannii Huang	47	6.5	6
32.	Elaeocarous japonicus S. et Z.	58	4.1	5
33.	Symplocos confusa Brand	19	28.8	14
34.	Symplocos confusa Brand	19	9.7	9
35.	Rhododendron tashiro Maxim.	107	3.8	3
36.	Tricalysia dubia Ohwi	71	4.2	5
37.	Castanopsis sieboldii Hatusima	10	14.6	11
38.	Dendropanax trifidus Mak.	77	3.1	6
39.	Cinnamomum doederleinii Engl.	41	6.3	7
39.	Schima wallichii korthals spp liuliuensis Bloem	12	5.1	6
40.	Castanopsis sieboldii Hatusima	10	17.1	12
41.	Tricalysia dubia Ohwi	71	5.6	5

b) Volume Analysis

Plot No. 1

Scientific Name	Volume/ha (m^3)	BA/ha (m^2)	Number/ha	Rate of Volume (%)	Rate of B.A (%)	Rate of No. (%)
Castanopsis sieboldii Hatusima	278.46	51.79	1100	67.17	62.35	18.97
Schima wallichii korthals spp liuliuensis Bloem	28.01	5.43	300	6.76	6.54	5.17
Distylium rasemosum S. et Z.	0.75	0.26	200	0.18	0.31	3.45
Cinnamomum camphora Presl	1.19	0.28	100	0.29	0.34	1.72
Rhaphiolepis indica Lindl. Var. insularis Hatusima	5.19	1.13	100	1.25	1.36	1.72
Ternstroemia japonica Thumb	5.06	1.62	900	1.22	1.95	15.52
Persea thunbergii Kosterm	1.06	0.28	100	0.26	0.34	1.72
Cinnamomum doederleinii Engl.	14.05	2.95	300	3.39	3.55	5.17
Neolitsea aciculata Koidz.	0.34	0.13	100	0.08	0.16	1.72
Daphniphyllum glaucescens Bl.ssp.teijsmannii Huang	18.58	4.55	200	4.48	5.48	3.45
Ilex liukiuensis Loesn.	14.91	3.43	400	3.60	4.13	6.90
Elaeocarpus japonicus S. et Z.	15.38	3.52	600	3.71	4.24	10.34
Cleyera japonica Thunb	12.65	2.54	100	3.05	3.06	1.72
Myrsine seguinii Leveille	9.27	2.57	500	2.24	3.09	8.62
Diospyros morrisiana Hance	2.10	0.50	100	0.51	0.60	1.72
Dendropanax trifidus Mak.	4.08	1.05	300	0.98	1.26	5.17
Tutcheria virgata Nakai	0.91	0.28	100	0.22	0.34	1.72
Microtropis japonica Hall.f.	1.86	0.50	100	0.45	0.60	1.72
Randia canthioides Champion	0.68	0.26	200	0.16	0.31	3.45
Total	414.53	83.07	5800	100	100.01	99.97

Plot No. 2.

Species code No.	V/ha (m^3)	BA/ha (m^2)	No./ha	V. (%)	BA (%)	No. (%)
10	368	54.45	500	69.8	61.34	10.42
12	40	7.73	500	7.55	8.71	10.42
13	9	2.67	800	1.79	3.01	16.67
30	32	5.68	200	6.06	6.40	4.17
48	29	6.19	500	5.49	6.97	10.42
50	14	2.93	400	2.60	3.30	8.33
55	1	0.28	100	0.20	0.32	2.08
57	8	1.95	300	1.54	2.20	6.25
58	0.3	0.13	100	0.06	0.15	2.08
75	15	3.42	200	2.91	3.85	4.17
78	4	1.13	300	0.67	1.27	6.25
106	0.4	0.13	100	0.08	0.15	2.08
107	1.6	0.63	200	0.31	0.71	4.17
112	0.9	0.28	100	0.17	0.32	2.08
113	1. 0	0.40	200	0.24	0.46	4.17
118	2.1	0.50	100	0.40	0.56	2.08
142	0.5	0.26	200	0.10	0.29	4.17
Total	527.6	88.77	4800	100	100.01	100

Species Code Number and Scientific Name

10	Castanopsis sieboldii Hatusima
12	Schima wallichii korthals ssp. liuliuensis Bloem.
13	Distylium rasemosum S. et Z.
30	Persea thunbergii Kosterm.
48	Ilex goshiensis Hayata
50	Ilex liukiuensis Loesn.
55	Meliosma oldhamii Maxim. var. rhoifolia Hatusima
57	Meriosma squamulosa Hance
58	Elaeocarpus japonicus S. et Z.
75	Scheffera octophylla Harms
78	Tutcheria virgata Nakai
106	Eurya japonica thunb.
107	Rhododendron tashiroi Maxim.
112	Symplocos microcalyx Hay.
113	Sympocos okinawensis Matsum.
118	Gardenia jasminoides Ellis f. grandiflora Mak.
142	Psychotria rubra Poir.

Plot No. 3

No	Scientific name	V/ha	BA/ha	Stem/ha	Percentage of		
		m^3	m^2	trees	V %	BA %	Stem %
1	Schima wallichii korthals spp. liuliuensis Bloem	2.5700	0.5000	100	3.30	3.85	6.67
2	Styrax japonicus S. & Z.	48.5300	7.0700	300	62.34	54.38	20.00
3	Elaeocarpus japonicus S. et Z.	13.2100	2.3300	200	16.97	17.92	13.33
4	Wendlandia formosana Cowan	7.3300	1.5600	400	9.42	12.00	26.67
5	Turpinia ternata Nakai	6.2100	1.5400	500	7.98	11.85	33.33
	Total	**77.8500**	**13.0000**	**1500**	**100.01**	**100.00**	**100.00**

Plot No. 4.

Species code No.	Volume/ha (m^3)	BA/ha. (m^2)	Number/ha.	Rate of V. (%)	Rate of BA (%)	Rate of No. (%)
10	234.3600	36.8400	700	68.94	65.34	17.95
12	82.6900	13.1900	500	24.32	23.39	12.82
13	2.3600	0.6700	400	0.69	1.19	10.26
17	5.7400	1.4700	500	1.69	2.61	12.82
23	1.6000	0.4100	200	0.47	0.73	5.13
32	3.2900	0.7800	200	0.97	1.38	5.13
45	1.4700	0.4100	200	0.43	0.73	5.13
57	3.000	0.9700	400	0.88	1.72	10.26
62	3.4400	0.9700	400	1.01	1.72	10.26
71	1.2500	0.4100	200	0.37	0.73	5.13
102	0.3400	0.1300	100	0.10	0.23	2.56
106	0.4100	0.1300	100	0.12	0.23	2.56
Total	**339.9500**	**56.3800**	**3900**	**99.99**	**100.00**	**100.01**

Coded Number and Scientific Name

10	Castanopsis sieboldii Hatusima
12	Schima wallichii korthals ssp. liuliuensis Bloem.
13	Distylium rasemosum S. et Z.
17	Ternstroemia japonica Thunb.
23	Syagium buxifoium Hook. & Arn
32	Rhaphiolepis indica Lindl .var. liukiuensis Kitam.
45	Neolitsea aciculata Koidz.
57	Meriosma squamulosa Hance
62	Myrsine seguinii Leveille
71	Tricalysia dubia Ohwi
102	Camellia japonica
106	Eurya japonica thunb.

Plot No. 5

No.	Scientific Name	V/ha	BA/ha	Stem/ha	Percentage of		
					V	BA	Stem
		m^3	m^2	trees	%	%	%
1	Castanopsis sieboldii Hatusima	192.64	27.76	1000	46.17	44.28	21.28
2	Schima wallichii korthals spp.liuliuensis Bloem	198.45	28.37	1300	47.56	45.25	27.66
3	Distylium rasemosum S. et Z.	0.34	0.13	100	0.08	0.21	2.13
4	Ternstroemia japonica Thumb.	0.91	0.28	100	0.22	0.45	2.13
5	Cinnamomum doederleinii Engl.	4.45	1.07	200	1.07	1.71	4.26
6	Neolitseea sericea Koidzumi	1.94	0.5400	300	0.46	0.86	6.38
7	Daphniphyllum glaucescens Bl.ssp.teijsmannii Huang	9.5600	1.9200	200	2.29	3.06	4.26
8	Ilex liukiuensis Loesn.	1.4300	0.3900	300	0.34	0.62	6.38
9	Rhus succedanea Linnaeus	2.3400	0.5000	100	0.56	0.80	2.13
10	Meriosma squamulosa Hance	0.4100	0.1300	100	0.10	0.21	2.13
11	Elaeocarpus japonicus S. et Z.	1.8800	0.5400	300	0.45	0.86	6.38
12	Myrsine seguinii Leveille	0.8200	0.2600	200	0.20	0.41	4.26
13	Tricalysia dubia ohwi	0.5400	0.2600	200	0.13	0.41	4.26
14	Dendropanax trifidus Mak.	0.4100	0.1300	100	0.10	0.21	2.13
15	Camellia sasanqua Thumb.	0.3400	0.1300	100	0.08	0.21	2.13
16	Randia canthioides champion	0.7700	0.2800	100	0.18	0.45	2.13
	Total	**417.2300**	**62.6900**	**4700**	**99.99**	**100.00**	**100.03**

Plot No. 6

No.	Scientific Name	V/ha	BA/ha	Stem/ha	Percentage per hectare V	BA	Stem
		m^2	m^3	stem	%	%	%
1	Castanopsis sieboldii Hatusima	98.51	15.7	800	46.99	42.92	19.05
2	Schima wallichii korthals spp liuliuensis Bloem	19.16	3.08	300	9.14	8.42	7.14
3	Ternstroemia japonica Thunb	6.54	1.50	300	3.12	4.10	7.14
4	Symplocos confusa Brand	46.82	6.95	200	22.34	19.00	4.76
5	Syzgium buxifolium Hook. & Arn	1.53	0.41	200	0.73	1.12	4.76
6	Cinnamomum doederleinii Engl.	6.5	1.34	400	3.10	3.66	9.52
7	Daphniphyllum glaucescens Bl.ssp.teijsmannii Huang	17.67	4.14	700	8.43	11.32	16.67
8	Diospyros morrisiana Hance	0.75	0.26	200	0.36	0.71	4.76
9	Elaeocarpus japonicus S. et Z.	0.41	0.13	100	0.20	0.36	2.38
10	Symplocos prunifolia S. & Z.	3.26	0.79	100	1.56	2.16	2.38
11	Tricalysia dubia Ohwi	2.51	0.69	300	1.20	1.89	7.14
12	Symplocos lucida S. & Z.	3.62	0.79	100	1.73	2.16	2.38
13	Dendropanax trifidus Mak.	0.48	0.13	100	0.23	0.36	2.38
14	Tutcheria virgata Nakai	0.27	0.13	100	0.13	0.36	2.38
15	Dendropanax trifidus Mak.	0.41	0.13	100	0.20	0.36	2.38
16	Rhododendron tashiro Maxim.	0.27	0.13	100	0.13	0.36	2.38
17	Cinnamomum doederleinii Engl.	0.91	0.28	100	0.43	0.77	2.38
	TOTAL	**209.62**	**36.58**	**4200**	**100.02**	**100.03**	**99.98**