

(3) Summary of Open Seminar

Topic of Open Seminar (Date)

Name of Speaker

Occupation of Speaker

Summary of Open Seminar

1) Estimation of Soil Hydraulic Properties with the Cone Permeameter. (Jul. 11, 2000)

Sondra ORDWAY

Civil and Environmental Engineering, University of South Carolina

Field application of the cone permeameter method was presented for estimating the soil-moisture retention curve and the hydraulic conductivity function in situ. The cone permeameter is designed to inject water into unsaturated soil and measure the cumulative inflow volume, while simultaneously measuring the pore water pressure responses with two tensiometer rings above the source. The data obtained from injection of water at sequentially increasing applied pressures are analyzed using an inverse modeling technique to obtain hydraulic parameter estimates. Previously, the cone permeameter was tested and performed well in two sandy materials. Here, results from field tests of the cone permeameter in loamy soils are discussed. The soil moisture characteristic curves and saturated hydraulic conductivity values obtained from these tests correspond well with results of other standard in situ and laboratory techniques.

2) Environmental Conservation in Rural Area and Watershed Management – Regional Variation of Nitrogen Outflow Potential in Lake Kasumigaura Watershed – (Aug. 1, 2000)

Toshio TABUCHI

Former Member of Science Council of Japan

Nitrogen Outflow Potentials (NOP) in each area within Lake Kasumigaura Basin are calculated by new model. The values of NOP are distributed in wide range (2.3-9.6 mg/l). It depends mainly on the density of population and pigs, and the percentage of the area of fields where much chemical fertilizer are used. The influence of the nitrogen removal in paddy fields on NOP is also estimated for irrigation period. The values of NOP are compared with the values of nitrogen concentration measured in the rivers in each area.

3) Impact of Japanese Encephalitis and Dengue Virus Infection in Southeast Asia (Nov.7, 2000)

Akira IGARASHI

Department of Virology, Institute of Tropical Medicine, Nagasaki University

Japanese encephalitis (JE) is caused by JE virus, a mosquito-borne flavivirus, and is prevalent in Asia monsoon area where rice cultivation in watered paddy fields and swine raising are common. Recent trends of human JE cases are: (1) marked reduction in Japan, and in the Republic of Korea, (2) gradual decrease in China, (3) epidemic outbreaks in Vietnam, Thailand, India, Nepal and Sri Lanka, and (4) endemicity in Malaysia, Indonesia, and Philippines. Molecular epidemiology did not show association between epidemic pattern of JE and the circulating virus genotypes. While multiple antigenic, subtypes of JE virus were recognized.

Dengue virus infection has been a serious health problem in world-wide tropical areas because of (1) increasing number of cases, (2) expanding epidemic areas, and (3) appearance of severe clinical

manifestations: dengue hemorrhagic fever (DHF)/dengue shock syndrome (DSS). Comparative sequencing virus strains isolated from patients with different clinical severity showed 3 subtypes of amino acid replacements, with different infection rates to the primary culture human white blood cells and secretion of TNF-alpha into the culture supernatant.

4) Natural Resources and Agriculture in Xinjiang Uigur Autonomous Region, the People's Republic of China (Nov.14,2000)

Characteristics of Water Transformation and its Effects to Environment in Xinjiang, China

Xin Li

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(Xinjiang Institute of Ecology and Geography, Chinese Academy of Science)

The regularity of water transform in stream forming area and disappearing area is very different. In stream forming area, water transform is mainly that groundwater flows out to form surface water. And in stream loss area, water transform is mainly that surface water seeps into ground. At the plain in front of mountains, when water resources finished the transform of surface water-groundwater-surface water, it may begin the second transform if there is structural basin in the lower reaches of river. However, water is less and less after the process of transform. Effect of water to environment can be divided into two types, natural affect and human effect. The changes of natural condition need a long time of geological period. The influences of human activities took place in a short time and with regional variation.

Natural environment, inland water distribution and water circulation has been changed greatly affected by human activities in Xinjiang, China. Population there has increased from 4.3 million in 1949 to 17.9 million in 1999. Human activities developed quickly in the inland watersheds in Xinjiang after 1950. More than 50% of river water is drawn into irrigation area, and all water in parts of small rivers is drawn to canal or reservoirs. However, there is evident hydrological effect caused by human activities.

Water distribution in arid land has changed. A lot of river water is drawn into oasis and water table inside of oasis has risen but declined outside of oasis. Water table has declined in some cities because of over pumping of groundwater. Stream process has changed after water drawing and drainage for irrigation. Runoff in the lower reaches of river has generally decreased, and the lower reaches of some rivers are even disappeared for stream. Large watersheds have been divided into several small watersheds. In some tributaries, most of the river water has drawn to irrigation area so that stream in the lower reaches has disappeared for years. There were 150 lakes in Xinjiang in 1950's; the total area of lakes was 9 000km². Some of them are contract and some are dried up. Tens of lakes in Xinjiang were dried up in last 40 years, and the area of lakes reduced for 4395km². Human activities caused continuous drying up and contract of plain lakes and changed the regional distribution of surface water. Water quality of inland rivers and lakes has generally deteriorated because they accept drainage water from farmland and factories.

Such conditions pose challenges for adequate water distribution based on monitoring, planning and management of water resources.

Soil Types in Xinjiang Uigur Autonomous Region, China

Tadashi NAKAI

National Institute for Agroenvironmental Sciences, Ministry of Agriculture, Forestry and Fisheries

The landscape and characteristic plants in Turpan Basin were introduced by color slides. Around 800 "Karez" system deliver irrigation water from the mountain to agricultural fields. The most dominant type

of soil is Brown Desert Soils. Salinization by CaSO_4 , NaNO_3 , and Na_2SO_4 poses serious problems on agriculture. Vegetables and fruit are sold in the market. Cotton, vegetables, rice, sweet-potato, and apple are produced.

Horticulture in Xinjiang, China

Kang LIAO

Visiting scientist to Okayama University

(Horticulture department, Xinjiang Agricultural University, Urumqi, Xinjiang)

Major fruits in Xinjiang are grape, apricot, apple, pear, peach, and jujube. More than 90% of them distributes in the southern part of Tianshan Mountain. Grape is the most important fruit in Xinjiang. The region produces around 30% of the national total of it, and about 60% of the production is concentrated in Trupan. The major cultivar, Thompson Seedless, is used to make green raisin. Apple is famous in Iri and pear in Korla. Other minor fruit like pistachio, strawberry, almond, walnut, and quince are also found in Xinjiang.

As for vegetables, melon, watermelon, tomato, pumpkin, Chinese cabbage, radish, onion, and chili are produced. The total growing area reaches 100,000 hectares and the total production about 3 million tons per year. The area for processing tomato is increasing rapidly in recent years. Vegetables production of Xinjiang is concentrated during summer and autumn. Winter vegetables are imported from the southern provinces of China.

Xinjiang is one of the three major producing areas of hop in the world. Hop is a very important industrial crop in Xinjiang. Hop production in the region occupies around 70% of the national total.

Advantages of horticulture in Xinjiang are (1) favorable climate with plenty of sunshine and great temperature change between day and night, (2) less damages by diseases and insects, and (3) mass production and rotational cropping. While disadvantages are (1) natural disaster such as by frost and strong wind, (2) low technological level and shortage in advanced knowledge, and (3) long distance to the market.

Ms. Qiman from the Xinjiang Agricultural University gave an additional comment that cotton cultivation in Xinjiang increased too much and the local government now tries to restrict its expansion.

5) Unstable Flow Patterns Affecting Leaching Characteristics of Homogeneous Sandy Soils (Dec. 14, 2000)

Ken KAWAMOTO

Faculty of Technology, Saitama University

To evaluate the effect of preferential flow patterns on the salt removal from salt mixed sandy soils under continuous rainfall infiltration, two-dimensional chamber tests were conducted. Six grades of initial water contents (within the range of 0.00-1.25% by weight) were chosen and three different rainfall intensities (15, 30, 180mm/h) were applied. When initial water contents were in the range between 0.00 and 0.75%, either fingering flows or several types unstable wetting fronts appeared. At first, the effect of unstable flow patterns on the leaching characteristics of salt affected sandy soils was presented quantitatively. Secondary, the mechanism of finger swelling was discussed based on the Green-Ampt approach. At last, the criterion of finger occurrence was discussed by the gravimetric time proposed by Philip (1969).

6) Factors Controlling the Cracking Patterns in Agricultural Soil (Dec. 14, 2000)

Shuichiro YOSHIDA

Hokuriku Agricultural experiment Station, MAFF

Cracks in clayey agricultural fields play an important role in drainage of excess water from the fields. The present study focuses on the relation between cracking patterns and farming operations in order to develop techniques to control cracks purposefully. An experiment performed in a clayey paddy field statistically proved that the transpiration from the crops planted in row, the row spacing, and the puddling frequency are the significant factors that affects the cracking pattern. The transpiration from the row-planted crops induces cracks running along the rows. The wider row spacing enlarges the width of cracks. The frequent puddling cause wider and simpler cracking patterns. Laboratory experiments and numerical simulations proved that the effect of transpiration from the row-planted crops was attributed to the bi-directional extraction of soil moisture and the resultant tensile effective stress between the rows. The sampled soil that had shrunk in situ revealed the influence of row spacing on distribution of cracks: the roots reinforced the soil against the stress, which results in the concentration of cracks in the domain where roots sparsely distributed. Therefore, the row spacing determines the crack intervals, then the width of them. The shrinkage characteristics measured for the soil taken from a puddled field suggested that the spatial variation in mechanical strength was an important property that can be influenced by the puddling frequency.

7) Forest Ecosystems in Tropics and its Use (Jan. 26, 2001)

Agroforestry – from View Point of Ecology –

Hiroyuki WATANABE

Graduate school of Agricultural Science, Kyoto University

The terminology used for Agroforestry (Agro-forestry) is as diverse as the number of persons who use it. The word Agroforestry itself is a new technical term, the utilization system of the same land for forestry combined with agriculture, animal husbandry or fisheries had been implemented for long period of time not only in the tropical zone but also in the temperate zone. Such a land utilization system, Agroforestry, has been adopted as one of the most effective methods for rehabilitation of forests and promotion of agriculture (food) production in the tropics in the international and national projects and cooperative works implemented by the NGOs or NPOs.

Tropical and developing countries are confronted with various problems i.e. restoration of forest, increase of food production, problems in living and earth environment, etc. Agroforestry is considered the proper measure to solve these problems.

Practical condition of Agroforestry is introduced, and advantages and disadvantages of Agroforestry from view point of ecology is also introduced and discussed to improve the system.

Biomass Management of Mangrove Forests

Akira KOMIYAMA

Fac. Agriculture, Gifu University

Mangroves play important roles in protecting coastal environments, and those forests are one of the productive ecosystems in the world (Choudhury, 1986). However, mangroves have been devastated by over exploitation, construction of living facilities, industrial uses like aquaculture, charcoal production, and tin mining. The proper management of mangrove ecosystems should be established urgently from the ecological view which takes the whole system into account.

In the first part of my lecture, I will show the condition of mangrove forests now in Thailand. The process of deterioration of those forests is discussed relating to the impacts come from domestic and industrial actions of people. An ecological balance between the forest productivity and those impacts is analyzed there.

In the second part, I will discuss the characteristics of mangrove forests in the context of biomass. The methodology of mangrove biomass estimation is explained both for above-and underground parts. The united allometric equations, that can apply for the mangrove forests covering wide areas and sizes, are tested. Finally, the importance of mangrove forests will be discussed from results of these biomass studies.

8) Results of Cooperative Research between Japan and China for Mu-Ush Shamo Desert and the Effect to a Local Society (Feb. 21, 2001)

Hong-ling YAO

Inner Mongolia Academy of Forest Science, China

In Mu-Ush Shamo desert, rapid desertification has advanced up to the nineteen-eighties. In 1982, Mu-Ush Shamo Res. Center was established to study a fixation of sand dune and effective land use. Since 1985, cooperative researches between Japan and China have been conducted by promote of Toyota Foundation and others, so that a fixation of sand dune has been succeeded. The vegetation cover ratio of sand dune along the road has reached a 69%. The vegetation cover of private land around the research center has increased, and annual incomes for residents have been increasing.

9) Current Topics on Parasitic Weed Research (March 7, 2001)

Ethylene Biosynthesis in Germinating *Striga hermonthica* Seeds

Yukihiro SUGIMOTO

Arid Land Research Center, Tottori University

Striga hermonthica (Del.) Benth seeds, conditioned at 30°C for 14 days, were treated with ethylene and ethephon. Ethylene induced little germination. On the other hand, ethephon effectively stimulated germination of *S. hermonthica* seeds at concentrations of 0.01 ppm or greater. Germination of *S. hermonthica* seeds, induced by GR24, was inhibited by AVG and 1-MCP. Inhibition by AVG was reversed by ACC, whereas that by 1-MCP was not. Seeds treated by GR24 produced ethylene, whose increase was in accord with increase of germination. These results are consistent with reported involvement of ethylene biosynthesis in *S. hermonthica* germination. Total RNA extracted from germinating seeds 12 h after GR24 treatment were used for PCR-based amplification of cDNA fragments encoding the ACC synthase- and oxidase-active site domains. Two distinct cDNA fragments encoding ACC synthase and a cDNA fragment encoding ACC oxidase were isolated. Northern blot analysis showed that expression of *SHACS1* exhibited a temporal change, after GR24 treatment, which was in accord with that of ethylene evolution from the seeds. *SHACS2* was expressed at a constant low level. Expression of *SHACO1* decreased with time after GR24 treatment. Based on these results, it is concluded that *SHACS1* is a germination-responsive gene and plays a crucial role in regulating germination of *S. hermonthica* seeds.

Parasitic Weed Germination Stimulants and Inhibitors Produced by Microbes

Hirimitsu NAKAJIMA

Faculty of Agriculture, Tottori University

Striga hermonthica (Del.) Benth is an economically important root parasitic weed that causes considerable losses in yield of several cereal crops including sorghum, maize, millet and rice in the arid and semiarid tropics. Germination of a *Striga* seed requires an exogenous stimulant exuded by roots of host and some nonhost plants. Induction of seed germination in absence of host plants is one of the most effective methods for *Striga* control as well as usage of specific germination inhibitors. In an attempt to develop effective natural germination stimulants to enhance depletion of *Striga* seed reserves in soils, 500 fungal isolates were screened, *in vitro*, for metabolites with activity as *Striga* germination stimulants. As a result, a strain of *Cercospora kikuchii*, a pathogen of soybean, was found to produce germination stimulants. These stimulants were purified from the culture filtrate of the fungus to afford two active fractions. Purification of one of them by HPLC gave no active fractions, but the mixture of these HPLC fractions showed the activity. Further purification of the other fraction resulted in isolation of an active substance, C₁₂H₁₀N₄O₅. A strain of *Fusarium solani* f. sp. *radicicola*, a pathogen of potato, was also found to produce a germination stimulant. The active substance was found to show the same chromatographic behavior as *p*-hydroxyphenylethanol, but its yield was too low to get sufficient spectroscopic data. In the course of screening search for metabolites with activity as *Striga* germination inhibitors, 63 fungal isolates were screened, and three fungal isolates were chosen. From these fungi, penicillic acid, harbarumin, putaminoxin and a new metabolite, C₈H₁₂N₂O₂, were isolated as *Striga* germination inhibitors. Harbarumin was not a lettuce germination inhibitor, indicating its selective inhibition against *Striga*.

Factors Affecting Conditioning and Germination of *Orobanche Minor* Seeds

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Orobanche minor seeds, like other root parasitic weeds including *Striga* spp., have special germination requirements, including pre-treatment (conditioning) in a warm moist environment for several days prior to exposure to exogenous germination stimulants. Optimal temperature for both conditioning and germination was found to be 23-25°C. Higher and lower temperatures inhibit and delay germination, respectively. In particular, exposure to supraoptimal temperature over 30°C within 12 hours before or after treatment with strigol, a germination stimulant, significantly reduced germination rates. This could partly be avoided by the treatment with gibberellic acid (GA₃) or fluridone, an inhibitor of abscisic acid (ABA) biosynthesis. Although endogenous ABA level in the seeds dropped very rapidly after imbibition, it did not increase after exposure to high temperature (30°C). Furthermore, there were no significant differences in ABA level between the seeds treated with fluridone and the untreated controls. These results indicate that *de novo* synthesis of GAs but not of ABA plays an important role in the conditioning and germination of *O. minor* seeds.

Protein Kinase A-like Genes in Parasitic Plants

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Fragments of two protein kinase A like genes were isolated from the parasitic plant, *Orobanche minor*, by polymerase chain reaction (PCR) using degenerate primers for kinase domains of various protein

kinases and by 3'- and 5'-RACE PCR. Amino terminal portions of the two genes are still absent but they were highly homologous to mammalian or yeast A kinases with all of the conserved sequences. One was exclusively expressed in seeds after conditioning and the other in germinated seeds and the stem and flowers in mature plants. In addition to the A kinase gene, fragments of the A kinase regulatory subunit was also cloned. These results suggest that A kinase system, which is not found by the genome sequencing of higher plants, is present in parasitic plants and that expression of protein kinase A's are regulated by the stage of the plants, suggesting that different types of A kinase dependent signaling pathways are present in seeds and mature plants.

10) Ethno-historical Study on Traditional Ways of Water Resources and Civilizations in the Sahara-Sahel Region (March 8, 2001)

Yoshihito SHIMADA

Graduate School of Letters, Nagoya University

Although Sahara-Sahel Region has suffered from severe drought and desertification and it is reported that this region has not known advanced utilization of water resources, it has however known subtle and well sophisticated water management techniques, and developed a Civilization forming many Islamic States and cities. One of the techniques is a foggara system irrigation developed in Sahara as a basis for oasis formation. The production capacity of oasis is not so high; oases dispersed in the vast desert have become focal points for the long distance trades covering the Sahara, which have, in their turn, become the basis of Sahara and sub-Saharan Civilizations. Another technique is contrasted one with the first because it is a natural and non-technical technique using the natural irrigation of the Niger River forming huge flood plains in the hedge of the Sahara. This Inner Delta of the Niger has become a big center, not only for African rice (*Olyza glabberima*) cultivation, but also for African pastoralism, fishing and even fluvial transportation. The so-called desertification has most severely affected this center because of the diminution of natural flood plains. And it is suspected that the constructions of dums and irrigation systems in the upper rivers aggravated this disaster.

11) Fundamental Studies on Water Circulation in a Field (March 9, 2001)

Microscopic Process of Bare Soil Evaporation and its Relation to Soil Physical Properties

Tsutomu YAMANAKA

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Faculty of Integrated Arts and Sciences, Hiroshima University

Results from numerical experiments and field observations were presented for assessing microscopic structure and its dynamic evolution of the evaporation zone within the soil. Computational results show that vaporization of soil water occurs at the bottom boundary of the dry surface layer (DSL) and the evaporation zone is thicker in the fine-textured soils than in the coarse-textured ones. Under conditions with diurnal changes in solar radiation and air temperature, soil water evaporates also within the DSL during the forenoon but condenses at there during the night. The amounts of the transient moisture storage and its re-evaporation within the DSL are much for the fine-textured soils relative to the coarse-textured soils. These phenomena and its relation to soil types are also indicated by isotopic concentration profiles of soil water and vapor flux derived by direct measurement of pore-air humidity. The most important soil-parameter determining the microscopic process of bare-soil evaporation is considered to be the specific

water capacity for the low water-content regime.

Evaluation of Hydraulic Conductivity and Strength Characteristics in Unsaturated Soil

Kohji KAMIYA

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Knowledge of the hydraulic properties and the strength characteristics in unsaturated soil is necessary to evaluate the slope stability during the seepage of rainfall and the mechanism of groundwater cultivation by the rainfall. As the example, based on the analysis of the relationship among the groundwater level, the pumping rate and the rainfall in the Osaka basin, the formation of groundwater level and cultivation are estimated. The factors of hydraulic property are the moisture characteristic curve, the coefficient of permeability and the air permeability. The data of these factors is being accumulated by the various methods of test. It is, however, recognized that the value of the permeability coefficient measured by the steady method (Uno et al., 1990) and that by the unsteady method (instantaneous profile method, Watoson, 1966) is different from each other. Although it is difficult to judge which method is better, the method must be established. On the other hand, to obtain the factors of hydraulic property easily, it is necessary to produce the database model for predicting the unsaturated hydraulic properties from the soil properties in domestic soils. The relationship between the hydraulic properties and the grain size distribution is examined. Now, to evaluate the hydraulic conductivity and the strength characteristics in unsaturated soil, we produce the new apparatus that can conduct permeability test and unconfined compression test with unsaturated rectangular soil specimen. The method of permeability test is the steady method produced by Uno et al. By comparing the tests of rectangular soil specimen with the tests of cylindrical specimen, the influence of the shape of specimen to the coefficient of permeability and the unconfined compression strength is examined. The adaptability of the new apparatus is verified. And then, the relationship between the coefficient of permeability and the unconfined compressive in unsaturated soil is taken into consideration.

Determination of Unsaturated Soil Hydraulic Properties Using *in-situ* Permeability Test and Genetic Algorithm

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It is well known that saturated and unsaturated hydraulic properties of soil are essential for accurate determination of water movement as well as contaminant transport in soil such as agricultural field, compacted soil and landfill. In this presentation, a new field experimental method of determining saturated and unsaturated soil hydraulic properties is introduced. In this method these properties are assumed to be represented by van Genuchten's closed-form expressions. Unknown parameters of this model are identified by Genetic algorithms (GA) incorporating finite element analysis of transient axisymmetric seepage flow. GA is search algorithms based on the mechanics of natural selection and natural genetics. They have become a popular global optimization method. A ponded single-ring infiltrometer technique, such as the Guelph pressure infiltrometer is performed. Simultaneously the measured change of soil water content with time and cumulative inflow data are used to identify unsaturated soil hydraulic function parameters. The advantage of the proposed method is that it allows estimation of the unsaturated soil hydraulic parameters by quite simple in situ permeability test data. The utility of the proposed method is demonstrated by using a numerical model and experimental data for Tottori dune sand.

12) Studies on the Remote Sensing for the Vegetation Area (Mar. 19, 2001)

Yoshiaki HONDA, Koji KAJIWARA, Hirokazu YAMAMOTO and Asako KONDA

Center for Environmental Remote Sensing, Chiba University

The monitoring system using a satellite data is effective for studies of the arid land. Concepts of general monitoring methods were introduced. Also, some examples of recent study conducted in the CEReS were represented: “Applied Study of Remote Sensing”, “Distributed Processing System for Bulk Data of Satellite”, “Studies on the Estimation of Biomass in Mongolia”, and “Studies on the Monitoring of the Vegetation using a Launched Sensor on Satellite”.

13) Ecophysiology of Trees in Tropics (March. 19, 2001)

Ikuo NINOMIYA

College of Agriculture, Ehime University

Tropical forest, especially tropical rain forest, has been considered to be wet and warm forest. However, top of the canopy, which is far from water, is suffered from frequently dry and hot stress. Canopy trees have to tolerate the dry and hot condition at their older stage, although they have passed through dark and wet condition on the forest floor at their younger stage. Namely, they should have survival abilities both in shade and open environment. On the other hand, their abilities to survive in open are important when we attempt to plant them on degraded area for ecosystem rehabilitation, since the area is usually cleared, hot and dry. In the hot and dry condition, when water consumption increase, they close stomata to save water, which in turn increase leaf temperature. They have to control both water consumption and leaf temperature without any inherent apparatus to adapt definite hot and dry conditions, which is useless at younger stage. How do they tolerate the hot and dry condition? Do they have any special mechanisms to control? The story will begin at the canopy of tropical rain forest in Sarawak.