Academic Prizes and Awards

1. Progress Award of the Japanese Association for Arid Land Studies, 2004

Studies on climate and human activity in arid areas of China and especially the Taklimakan Desert

The Japanese Association for Arid Land Studies presented its progress award to Dr. Mingyuan Du in 2004 for his outstanding research activities on climate and human activity in arid areas of China, especially in the Taklimakan Desert.

Dr. Du has been conducting research in this field for nearly 14 years. In 1991, as an STA (Science and Technology Agency of Japan) fellow at the Tropical Agriculture Research Center (TARC) of MAFF, he began cooperative research on the prevention of sand drift in arid lands. TARC introduced polyethylene windbreak nets to arid China in an effort to prevent sand drift and wind erosion. The cooperative research results suggested that the establishment of wide, multi-windbreak belts, including shrub and grass shelter belts, windbreak nets, and windbreak forest shelter belts, should be considered at the margins of oases to prevent sand drift and desertification. Windbreak nets can be used initially as front-line strategies because of their convenient setup and benefits, which include the protection of vegetation against sand blast, control of soil and wind erosion, and creation of microclimates (e.g. by reduction of evapotranspiration) conducive to vegetation growth. Polyethylene windbreak nets are now widely used in the arid areas of China.

Since 1991, Dr. Du has focused his research on the relationship between recent climate change and human activity in the arid areas of China, and especially in the Taklimakan Desert. By analyzing meteorological data, performing on-the-spot investigations, and interviewing farmers, he has found that the local climate in Xinjiang, China, and especially in the oases of the Taklimakan Desert, has become favorable for agricultural activity: the temperature has increased in winter and decreased in summer, and precipitation has increased in summer. This change in the local environment is mainly the result of climate change in recent years owing to the expansion of oases, an increase in the number of plantings and growth of windbreak forests, and increased control of (and thus a decrease in) the cutting of firewood. Thus, he points out that there are two different feedback relationships between oasis development and climate change: (1) oasis development ⇒ climate becomes favorable ⇒ more development of oases ⇒ climate becomes more favorable, and (2) oasis degradation ⇒ climate becomes worse ⇒ more degradation of oases ⇒ climate becomes even worse. This feedback effect occurs depends mainly on how people use the natural resources, and especially the water resources, in arid lands. Dr. Du suggests that it is very important to use water resources efficiently but not to expand the area of oases in future.

Over the past 14 years, Dr. Du and his colleagues have published 20 papers in the *Journal of Arid Land Studies* of The Japanese Association for Arid Land Studies, as well as more than 30 papers in other academic journals. His research achievements are proving very useful in the development of arid areas of China, especially in the Taklimakan Desert.

2. Research Award of the Japanese Society of Soil Science and Plant Nutrition, 2004

Establishment of methods for assessing allelopathy, and isolation of allelochemicals useful in agriculture

In 2004 Dr. Yoshiharu FUJII, a research leader in the Chemical Ecology Unit, was awarded the 49th Research Award of the Japanese Society of Soil Science and Plant Nutrition.

His achievements for this award are summarized as follows:

1) Exploitation of new methods of assessing allelopathy

Allelopathy, a chemical interaction between plants and other life, is a complex phenomenon that has 4 routes of action. To evaluate route 1 (root exudates), a method of mixed planting of donor and acceptor plants in agar medium in the same plant box was established and named the “Plant Box Method”. To evaluate route 2 (leaf leachates), the inhibitory effect of leaf litter was evaluated by placing leaves between 2 layers of agar, a method named the “Sandwich Method”. To investigate route 3 (emission of volatile chemicals), the “Dish Pack Method”, using packing apparatus for evaluation of atmospheric effects, was established. For route 4 (release of allelochemicals to the rhizosphere soil), the “Rhizosphere Soil Method”, using rhizosphere soil separated from the surface of the root, was exploited.

2) Screening of allelopathic plants by bioassay

By using specific methods, Dr Fujii evaluated the allelopathic activities of 1200 plant species over a 10-year period at NIAES. The most promising plants were velvet

bean (*Mucuna pruriens*), hairy vetch (*Vicia villosa*), *Lycoris radiata*, *Sphenoclea zeylanica*, and *Duranta repens*. Using the Plant Box Method, rice cultivars with strong allelopathic characteristics were also evaluated, and red rice (the old traditional shrine rice) cultivars were found to be strongly allelopathic.

3) Isolation of active constituents of allelochemicals

To isolate active allelochemicals, in addition to the specific activities of natural chemicals in plants, their concentrations were taken into consideration. By means of this strategy, L-3,4-dihydroxyphenylalanine (L-DOPA) was isolated from the velvet bean. Lycorine and related alkaloids were isolated from *Lycoris radiata*. Rutin, gallic acid, and fagomine were isolated from buckwheat. Methyl isothiocyanate was isolated from the spider lily (*Cleome spinosa*). From a newly invasive weed, *Sphenoclea zeylanica*, a series of new cyclic dithiolane compounds were isolated and named Zeylanoxides. From the steam distillation concentrate of cut-off mixtures of young tree twigs of Japanese endemic trees, 1,2-propanediol was identified as a chemical that promotes plant growth.

4) Practical application of allelopathic cover plants in the field

Hairy vetch was found to be very promising for weed suppression and vegetation control in the field. Hairy vetch is a leguminous pasture plant, and when sown in fall it covers the surface of the land almost completely by spring, and suppresses weeds almost completely. After blooming in June, it eventually dies and produces a heavy mulch-like straw. Hairy vetch could produce 200 to 400 kg of nitrogen per hectare by nitrogen fixation and could serve as a good green manure. These characteristics led Dr Fujii to conclude that hairy vetch is very suitable for weed control under fruit trees or in abandoned fields. Hairy vetch is now gradually being distributed in Japan for these purposes.

Cyanamide was identified as an allelochemical in hairy vetch. Cyanamide is a constituent of the well-known synthetic nitrogen fertilizer calcium cyanamide, but Dr Fujii's was the first finding of cyanamide as a natural chemical in a plant.

3. Award of The Society for the Study of Evolution, Japan 2004

Dr. Nobuhiro Minaka, Department of Global Resources, won the Award ("Education and Outreach of Evolutionary Biology") of The Society for the Study of Evolution, Japan, in 2004. Dr. Minaka won this award for his excellent management of the "EVOLVE" mailing list over 10 years.

The EVOLVE mailing list is an Internet community of scientists and researchers who have general or specific interests in evolutionary biology. Dr. Minaka founded this mailing list on a server of the Computer Center for Agriculture, Forestry and Fisheries Research, MAFF, in September 1994. It is at present the only academic mailing list for evolutionary biology in Japan. The cumulative number of members of EVOLVE exceeded 1800 in July 2005. Members include professors, researchers, graduate students, and high school teachers. Various themes and topics concerning the evolution of organisms have been discussed and debated on EVOLVE, and some threads of mail exchanges have resulted in collaborative projects and activities at academic meetings and congresses, as well as books and other scientific activities.

The Award Committee of The Society for the Study of Evolution, Japan, evaluated Dr. Minaka's management of this mailing list over the past 10 years as a remarkable achievement in enlightenment and outreach regarding evolutionary thought to wider and younger generations in Japan.

4. The Japanese Society of Soil Science and Plant Nutrition Award for the Encouragement of Young Scientists

Effect of interaction between ligands and ions on chemical reactions in soil

The Japanese Society of Soil Science and Plant Nutrition presented its annual award for the encouragement of young scientists to Dr. N. Yamaguchi, because her research has contributed remarkably to the advancement and development of soil chemistry pertaining to soil surface reactions.

To predict the mobility and future risks of nutrients

and pollutants in the soil environment, it is important to elucidate the mechanism of the physicochemical reactions occurring at the soil–water interface. Dr. N. Yamaguchi has addressed sorption and complexation reaction mechanisms by focusing on the interactions between the ligands and ions that play important roles in the reaction processes.

Water molecules are the most important ligands involved in the sorption reaction at the soil–water interface. Dr. Yamaguchi has applied a precise thermodynamic technique, dilatometry, to determine changes in the interaction between water and ions during the adsorption of ions on soil minerals. She has succeeded in providing the first experimental evidence that ions and soil minerals release hydrated water molecules to form inner-sphere complexes. The affinity of the oxyanions to soil minerals is related to the hydration characteristics of the oxyanions, i.e., to the interaction between water and the ions.

Dr. N. Yamaguchi also applied some molecular-scale approaches, namely X-ray absorption fine structure (XAFS), diffuse reflectance spectroscopy (DRS), and nuclear magnetic resonance (NMR) to investigate the effects of organic ligands on the kinetics and mechanism of Ni sorption onto soil minerals, and also the formation and disappearance of the phytotoxic Al tridecamer (Al_{13}). Formation of surface-induced precipitates played an important role in the immobilization of Ni and other metals in non-acidic soils. The presence of ligand complexing with Ni inhibited precipitate formation and thereby retarded the stabilization of Ni in the soil systems. In addition, the carboxylic group of low-molecular-weight organic acids and humates played a role in decreasing the concentration of Al_{13}; therefore, the phytotoxicity of Al_{13} was less important when the soil contained sufficient amounts of organic ligands.