

## 2.8 Activities of COE Researchers

### (1) Dr. Shuhei Okada

#### Summary of research

##### 1. Relationship between Sand Movement and Meteorological Parameters on Tottori Sand Dune

The changes in sand surface level of the natural monument area on Tottori Sand Dune were measured at monthly intervals since 1992. Sand movement and the relationships between sand movement and meteorological factors were explored for functional relationships. These relationships indicated that the changes in sand surface level as induced by meteorological parameters (wind, precipitation, and snow cover) varied. On the other hand, the analysis also showed that either monthly or annual changes in sand surface level were larger in winter than the other seasons. The annual changes in sand surface level increased, showing a tendency for erosion. In addition, the contour maps of the change in surface level were made. The large and small changes in sand surface level were shown in these maps. The analysis of these maps indicated that the changes in sand surface level were affected by topography and windbreak forest.

##### 2. Change of the spectral reflectance of paper mulches depend on solar incidence

In order to use paper properly as a mulch for plant production, this research investigated the optical characteristics of two recycle papers (Emboss and Eco, with beige 120g/m<sup>2</sup>, and dark brown 55g/m<sup>2</sup>, respectively) and a silver-polyethylene film (Silver, mixing aluminum powder). We measured transmittance and reflectance of these materials as mulches under a light controlled and an open field (Tottori Sand Dune) conditions.

Used as mulches, all three materials would inhibit weed growth as they prevented the penetration of light at 660nm, which simulates weed germination. Mean transmittance at 400-700nm for all the three was less than 1%. The reflectance of Emboss and Eco was low for ultraviolet (350-400nm) but high for visible (400-700nm) and near infrared rays (700-2500nm). The opposite was found with Silver.

The radiances of three mulches in the fair and cloudy day were compared. The radiance of three mulches in the cloudy day were high for ultraviolet but low for visible and near infrared rays.

The light scattering property of each material was measured at 5 vertical to horizontal angles: 30° , 60° , 90° , 120° and 150° . Silver reflected light more strongly in the direction against the angle of the sun. In contrast, Emboss generally reflected more light than Eco in all directions, both had no significant differences among the directions. Because Emboss reflects photosynthetically active radiation (400-700nm) more extensively than Silver, it may be better for plant photosynthesis.

#### Publications:

- 1) OKADA, S. and KAMICHIKA, M., 2002: Relationship between Sand Movement and Meteorological Parameters on Tottori Sand Dune. *J. Sand Dune Research.*, 49, 1, 11-20.
- 2) OKADA, S., KAWAMOTO, T. and KAMICHIKA, M., 2001: Change of the spectral reflectance of paper mulches depend on solar elevation. *Chugoku • Shikoku branch report. J. Agric. Meteorol.*, 14, 38-41.

### (2) Dr. Mina Yamada

#### Research Activities:

My research has been focused to the ameliorative effect of zeolite to the growth at saline and sodic soil. Salinization and sodication of soils are major problems in dry land farming. The ameliorative effects of Ca and K on plant growth under Na-rich media have been widely recognized. The global production of coal fly ash in thermal power plants exceeds 550 Mt per year, while the recycling rate is only about 15 to 20%. Artificial zeolites have been made from coal fly ash which shows a high cation exchange capacity and

displays a molecular sieve function, with low levels of toxic trace elements. Artificial zeolites with a large quantity of K or Ca, therefore, can be expected to ameliorate the growth of plants in a Na-rich medium, but the efficiency has not yet been fully evaluated. Our results indicated that both types of artificial zeolites were able to improve the growth performance of beet and tomato in saline and sodic soils. But they were not improve the growth of corn.

**Publications:**

1. Achamadi Jumberi, Mina Yamada, Satoshi Yamada, and Hideyasu Fujiyama (2001): Salt tolerance of grain crops in relation to ionic balance and absorbing ability of microelements. *Soil Sci. Plant Nutri.*47, 657-664
2. Thahei Yamamoto, Mina Yamada, Guang Wen, Aritune Yuya (2002): Application of recycling materials or soil degradation in arid lands. *Jour. JSIDRE* 70, 597-600
3. Satoshi Yamada, Mitsuru Osaki, Takuro Shinano, Mina Yamada, Miyoko Ito, and Asep Tata Pernato (2002): Effect of potassium nutrition on current photosynthesized carbon distribution to carbon and nitrogen compounds among rice, soybean, and sunflower. *J. Plant Nutri.* 25, 1957-1973
4. Mina Yamada, Maki Uehira, Lee Song Hun, Kenji Asahara, Tsuneyoshi Endo, Anthony Egrinya Eneji, Sadahiro Yamamoto, Toshimasa Honna, Tahei Yamamoto, and Hideyasu Fujiyama (2002): Ameliorative effect of K-type and Ca-type artificial zeolites on the growth of beets in saline and sodic soils. *Soil Sci. Plant Nutri.*48, ( in press )

**National symposium:**

Mina Yamada, Kenji Asahara, and Hideyasu Fujiyama (2002), Effect of the artificial zeolite on the growth at sodic soil. Abstracts of the annual meeting. Japanese Society of Soil Science and Plant Nutrition. Vol.48, pp 67 (in Japanese)

**(3) Dr. Kyoko Nakamoto**

**Summary of Research**

Soil CO<sub>2</sub> concentration profile and micrometeorological elements were measured in a sand dune field at the Arid Research Center, Tottori University between 21 July 2001 and 5 January 2002. Soil CO<sub>2</sub> concentration at various depths were measured directly by small IRGA buried in the soil. The soil CO<sub>2</sub> concentration was approximately twice or 3 times greater than that of the atmosphere and soil CO<sub>2</sub> concentration increased with depth. Soil CO<sub>2</sub> concentration increased at night and decreased in the daytime similar to that of the atmosphere, while there was a small phase lag with depth. As soon as the rain began, soil CO<sub>2</sub> concentration increased rapidly especially at the depth of less than 10-15cm; it was nearly constant during a rainfall event, and then decreased as soon as the event was completed. The increase in CO<sub>2</sub> concentration at the deeper layer was smaller than that of the upper surface layer. The increase in soil CO<sub>2</sub> concentration during rainfall events would be influenced by rainfall intensity and soil temperature. It is concluded that the air flow from the soil to the atmosphere would be intercepted by the saturated layer which was formed within the surface soil layer and this interception would increase the concentration of CO<sub>2</sub> in the soil. For the sand dune soil, the high percolation would exhaust the film of water easily to restore the air flow immediately so that soil CO<sub>2</sub> concentration would drop down rapidly.

**Publication**

- 1) Nakamoto, K., Kamichika, M., Hayakawa, S. (2001): Diurnal changes in atmospheric CO<sub>2</sub> concentration over a sand dune field in a coastal area., *Sand Dune Research* 48 (1) 22-29

**Domestic workshop and meeting**

- 1) Nakamoto, K., Kamichika, M., Hayakawa, S., Yamamoto, T. (2001): CO<sub>2</sub> concentration change of soil surface and soil layer in a bare sand dune field with percolation of soil water., Annual meeting of the Society of Agricultural Meteorology of Japan, 136 (Tsukuba City) .

- 2) Nakamoto, K., Kamichika, M., Hayakawa, S. (2001): Soil CO<sub>2</sub> profile in a bare sand dune field., Annual meeting of the Society of Agricultural Meteorology of Japan, 68-69 (Takamatsu City).