

2.8 Activities of COE Researchers

(1) Dr. Shuhei Okada

Summary of research activities

1. Relationship between wind environment and grain-size distribution of sand in Tottori Sand Dune

Distribution of wind speed and direction were observed in Tottori Sand Dune and the granulometric analysis was conducted using surface sands of this area. Median diameters and sorting coefficient of the sand were used as indexes of grain-size distribution in the granulometric analysis. The general properties of wind effect to sand movement were analyzed using the wind data of Arid Land Research Center, Tottori University, adjacent to the observation field. The wind route and the area of strong wind and weak wind were confirmed by the mobile observation when the NNW wind was dominant in Tottori Sand Dune. In addition, the distribution of wind speed and direction, median diameter and sorting coefficient of sand, topography and vegetation were compared. The results show the effects of topographies and vegetation on grain-size distribution and some relations between winds and the grain-size distribution.

2. Study on classification method of plant community applied horal changes of radiance

The spectral radiances of plant community relate to solar elevation. The object in this study is examination of classification method of plant community applied horal changes of radiance. 5 herbaceous communities were measured spectral radiances at riverbed of Sendai River, Tottori (wavelength : 350-2500nm, FOV:25 degree). As the result, it was cleared that the extent that solar elevation affects to radiance of plant communities are depend on plant structures. The index to classify the plant communities were developed applying this characteristic. Usual index, NDVI, and the developed index were calculated with accumulated values of wavelength of Landsat-TM and SPOT-HRV that were major satellite data for vegetation monitoring. Although, 5 plant communities were classified to 2 classes by NDVI, the new index could classify to 3 classes.

Publications:

- 1) Okada, S., Y. Matsubara, K.Otsuki, and M. Kamichika, (2000) : Relationship between wind environment and grain-size distribution of sand in Tottori Sand Dune. *J. Sand Dune Research*. 47(1):12-19.
- 2) Okada, S., H. Miura, H. Kageyama, M. Kamichika, (2000) : Study on classification method of plant community applied horal changes of radiance. *JSPRS, Proceedings (Autumn)*. 35-38

(2) Dr. Mina Yamada

Summary of 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 the major problems in the dry land farming. And the coal ash waste disposal is an arising problem. The artificial zeolite is transformed from the coal fly ash by removing toxic trace elements contained, and has a high cation exchange capacity and molecular sieve function. Utilization of the artificial zeolite will contribute to relieving the coal ash disposal problem. From our research, it has been clearly that the artificial zeolite could ameliorate the growth of beet, tomato, bean, and corn at high sodic soil.

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 Nutr.* (In printing)
2. Mina Yamada, Maki Uehira, Lee Song Hun, Kenji Asahara, Tsuneyoshi Endo, Sadahiro Yamamoto, Toshimasa Honna, Tahei Yamamoto, and Hideyasu Fujiyama (2001) : Ameliorative effect of the K-type and Ca-type artificial zeolite on the growth of beets in saline and sodic soils. (Submitted to *Soil Sci.*

Plant Nutr.)

National symposium:

1. Hirofumi Shimoda, Mina Yamada, Miki Kanno, Takashi Kimura, Yukio Yao, and Hideyasu Fujiyama (2000) : The use of artificial zeolites for agriculture (1) The effect of compost with artificial zeolites on the growth of plants at sand soil. Abstracts of the annual meeting. Japanese Society of Soil Science and Plant Nutrition. Vol.46, pp 172 (in Japanese)
2. Mina Yamada, Maki Uehira, Yoko Katsube, Takayuki Sasaki, Lee Song Hun, Sadahiro Yamamoto, Toshimasa Honna, and Hideyasu Fujiyama (2000) : The use of artificial zeolites for agriculture (2) The effect of artificial zeolites on the growth of plants at saline and sodic soil. Abstracts of the annual meeting. Japanese Society of Soil Science and Plant Nutrition. Vol.46, pp 172 (in Japanese)
3. Mina Yamada, Maki Uehira, Lee Song Hun, Tsuneyoshi Endo, Sadahiro Yamamoto, Toshimasa Honna, and Hideyasu Fujiyama (2000) : Ameliorative effect of the K-type and Ca-type artificial zeolite on the growth at sodic soil. Abstracts of the annual meeting. Japanese Society of Soil Science and Plant Nutrition. Vol.47, pp182 (in Japanese)
4. Yoko Katsube, Mina Yamada, Satoshi Yamada, and Hideyasu Fujiyama (2000) : Effect of K and Ca on the plants subjected to sodium salinization. Abstracts of the annual meeting. Japanese Society of Soil Science and Plant Nutrition. Vol.47, pp374 (in Japanese)
5. Mina Yamada (2000) : Nutritional characteristics of plants under low N and low P conditions which has been brought up the problem at arid regions. Proc. of the symposium of Soil Physics section of JSIDRE, pp47-55 (in Japanese)

(3) Dr. Kyoko Nakamoto

Summary of research activities

In a arid land, the soil salinization is one of the most important problem as a factor of desertification. The simultaneous movement of saline and water has been investigated by a lot of researchers, however the researches that treat the effect of soil CO₂ on salinization are a few. There are many uncertainty about the behavior of soil CO₂ and the transport of CO₂ between soil and atmosphere so that soil CO₂ concentration and micrometeorological elements were measured at a sand dune field, Arid Research Center, Tottori University between 16 February and 13 March. Soil CO₂ concentration was measured by the direct measurement of soil CO₂ by the small IRGA which was buried in a soil. Soil CO₂ concentration at the depth of 10cm was approximately twice larger than that of atmosphere. Soil CO₂ concentration decreased during a daytime and it increased at night, similar to diurnal change of atmospheric CO₂ concentration. On set of rain fall, soil CO₂ concentration increased rapidly and it came to nearly constant during a rain fall event, and then decreased as soon as a rain fall event was completed. Soil moisture also increased during a rain fall event and this high ratio of liquid phase could cause the large increase of soil CO₂ concentration. However, even in the case of the light rain which would not increase soil moisture, this interesting behavior was exist. The behavior of CO₂ concentration was different between the soil and the atmosphere in the case of rain fall. It concluded that the mass flow from the soil to the atmosphere would be intercepted by the film of water which was formed at the surface soil layer through percolation of rain drops and this interception would increase concentration of CO₂ gas in the soil. At a snowfall, soil CO₂ concentration increased similar to the rainfall event. However, it indicated high value while the soil surface was covered with snow. After the snow melt, it decreased. The increase of CO₂ concentration which was brought by snowfall event depended on the snow depth, air temperature and soil temperature. The snow cover would give the certain amount of resistance to diffuse soil CO₂ to the atmosphere. During the colder whether condition, it was smaller than the warmer condition even if the soil moisture increased. It suggested that the microbial activity which produces CO₂ in a soil would drop down under the cold whether. For the sand dune soil, the high percolation would disappear the film of water easily to restore

the mass flow immediately so that soil CO₂ concentration would drop down rapidly.

National work shops and meetings

1. Nakamoto, K., Kamichika, M., Hayakawa, S. (2000) : Diurnal changes in atmospheric CO₂ concentration over a sand dune field in a coastal area., Abstracts of Annual Meeting of the Society of Agricultural Meteorology Japan held in (Miyazaki City), 186-187.
2. Nakamoto, K., Kamichika, M., Hayakawa, S. (2000) : Measurement of soil CO₂ concentration under the mulching condition., Abstracts of Annual Meeting of the Society of Agricultural Meteorology Japan (Miyazaki City), 188-189.
3. Nakamoto, K., Kamichika, M., Hayakawa, S. (2000) : Changes in soil CO₂ concentration on set of rainfall events in a sand dune field., Agricultural Meteorology of Chugoku-Shikoku (Izumo City), 10-11.
4. Nakamoto, K., Kamichika, M., Hayakawa, S. (2000) : Changes in soil CO₂ concentration on set of rainfall events in a sand dune field., Abstracts of Soil physics research group of Agricultural Engineering Japan (Tottori City), 10.

(4) Dr. Hisashi Tomemori

Summary of research activities

My major research activities are to use the diluted sodium which is contained within irrigation water for the growth of crops.

Title : *Diluted Sodium Effects to Replace Potassium Partially in Spinach.*

In order to investigate an interaction between Na⁺ (at a lower concentration) and K⁺ effects, spinach (*Spinacia oleracea* L. 'Atlas' and 'All Right') and komatsuna (*Brassica rapa* L. 'Andou-wase') were grown under various combination of Na⁺ and K⁺ application.

One variety of spinach grew better under Na⁺ : K⁺ = 2 : 8 solution than under Na⁺ : K⁺ = 0 : 10. In case of komatsuna, no advantageous effects of Na⁺ were observed.

Five levels of K⁺ doses were applied on spinach and komatsuna with or without Na⁺. The Na⁺ was added by the supply of 20mM NaCl for irrigation. Shoot fresh weight of spinach 'Atlas' increased with Na⁺ application irrespective of K⁺ doses. For 'All Right' Na⁺ was effective in the lower doses of K⁺. Shoot fresh weight of komatsuna decreased with Na⁺ application.

Photosynthetic rate of spinach 'Atlas' increased with Na⁺ application at low and slightly high doses of K⁺, while that of 'All Right' did at only low dose of K⁺. Photosynthetic rate of komatsuna was higher under no Na⁺ application. Stomatal conductance of spinach and komatsuna showed a similar tendency as photosynthetic rate did. It was suggested that stomatal closure or disclosure was affected by K⁺ and Na⁺ application.

It may be possible for spinach to replace potassium fertilizer partially by low concentration of sodium.

Educational activities

I supplied technical support of the experiments for graduate and undergraduate students on horticulture. Sometimes I have special teaching of plants of arid land, desertification and sustainable agriculture for students of junior high school and schoolchildren visited to ALRC.