

## 1. 研究活動 / **Research Overview**

## 1. 研究活動 (2013年4月～2014年3月)

### 1.1 研究活動概要

#### (1) 乾燥地研究センターについて

乾燥地研究センターは国立大学法人鳥取大学の独立部局であると同時に、共同利用・共同研究拠点である。その設置目的は、「乾燥地における砂漠化や干ばつなどの諸問題に対処し、乾燥地における自然—社会系の持続性の維持・向上に資する研究を中核的研究教育拠点として推進し、乾燥地科学分野の研究者の利用に供すること」にある。

文部科学省の研究拠点形成費等補助金事業による21世紀COEプログラム(平成14～18年度)やグローバルCOEプログラム「乾燥地科学拠点の世界展開」(平成19～23年度)により、乾燥地科学分野の研究水準の向上と世界をリードする創造的な人材を育成し、研究・教育の世界的ネットワークも形成した。

本拠点形成の目的は、研究面においては、乾燥地研究センターがその前身を含めてこれまでに蓄積した砂地における植物生産や植生回復に関する知見と技術を、広く世界の乾燥地土壌に適用可能なものへと高度化するとともに、これに社会経済分野や医学分野などの知見や技術を融合させて、世界の砂漠化対処に資する、健康的な人間生活の営みを保障する「新たな乾燥地科学」を構築することにある。一方、教育面においては、大学院生(修士課程、博士課程)、研究生、JICA等からの外国人委託研究員等の教育を担当し、乾燥地の砂漠化対処に関わる国際機関や企業、NGOなどが必要とする研究者や技術者を養成することである。

本拠点の形成は、世界の乾燥地科学の発展、国連砂漠化対処条約に係る我が国の貢献義務の履行及び当該分野の人材育成にとって重要な意義を有する。

平成23年には、黄砂プロジェクト「東アジア砂漠化地域における黄砂発生源対策と人間・環境への影響評価」(平成23年度～平成27年度)が文部科学省特別経費事業に採択され、東アジアにおける黄砂の発生メカニズムの解明、黄砂の影響評価および発生源対策技術の開発に取り組んでいる。

鳥取大学は平成24年度に引き続き、文部科学省の平成25年度研究拠点形成等補助金「卓越した大学院拠点形成支援補助金」に採択された。

また、篠田雅人教授を研究代表者とする、平成25年度科学研究費助成事業(基盤研究(S))「乾燥地災害学の体系化」(平成25年度～29年度)が採択された。

さらに、岡本昌憲助教(テニユアトラック教員)とカリフォルニア大学リバーサイド校を中心とした、国際共同研究チームが、植物の乾燥ストレス耐性を向上させる化合物の発見に成功し、平成25年7月2日、本研究結果が米国科学アカデミー紀要『PNAS』オンライン版に掲載された。

平成26年2月には、中国科学院寒区旱区環境工學研究所、蘭州大学草地農業科技学院及び本センターが、ゼロネット土地劣化の目標到達を提唱し、「民勤における砂漠化対処共同研究に関する覚書」を締結した。

平成26年3月には、木村玲二准教授が「東アジア黄砂発生モニタリングシステム」を当センターのホーム

## 1. Research Overview (April 2013-March 2014)

### 1.1 Outlines of Research Activities

#### (1) About Arid Land Research Center

The Arid Land Research Center (ALRC) is an independent department of Tottori University and, at the same time, is a Joint Usage/ Research COE. The mission of the ALRC is to conduct research on desertification and to develop sustainable agricultural practices in arid and semi-arid areas. The door is open to all researchers who are engaged in the field of Dryland Science.

Tottori University had undertaken the 21st COE Program “Program for Arid Land Science” for five years from FY 2002 to FY 2006, and Global COE program “Global Center of Excellence for Dryland Science” for five years from FY 2007 to FY 2011, both of which were funded by the Ministry of Education, Culture, Sports, Science and Technology (MEXT). These MEXT-sponsored programs had helped establish a global network in terms of education and research, while contributing to the enhancement of the level of research in the field of the dryland science and nurturing internationally-active, competent researchers.

The goals of the establishment of the Center are, with regard to research, to advance knowledge and technologies concerning plant production and revegetation of deserts, which the Arid Land Research Center and its predecessor have accumulated, so it can be widely applied to arid land soils around the world. Simultaneously, blending this with knowledge and technologies in the social economics and medical fields etc., to build a new Science of Arid Land that contribute to combat global desertification and ensure people's healthy daily lives. In the educational field, ALRC's mission is to nurture researchers and advance technologists to deal with arid lands that are required by international organizations, private companies, NGOs etc. through educating graduate students (Master's and Doctoral courses), research students, and international researchers from Japan International Cooperation Agency (JICA), etc.

The establishment of the Center is extremely significant in terms of fulfilling Japan's obligation to contribute to the development of the world's Science of Arid Land and to the United Nations Convention to Combat Desertification and the training of personnel in this field.

We have started the Asian Dust Project “Assessment and Control of Dust Emission in Degraded Drylands of East Asia” sponsored by MEXT in FY 2011. The goal of this five year project is to assess the dust effects on human health and environments, to elucidate the dust emission and sandstorm mechanisms, and to develop mitigation techniques.

Tottori University was selected by MEXT for an “MEXT Grant for Formation and Development of Outstanding Hub Graduate Schools” in FY 2012 and FY 2013, a subsidy for the cost of forming its research center.

In FY 2013, as the principal investigator, Professor M. Shinoda research titled “Integrating dryland disaster science” was selected as Grant-in Aid for Scientific Research (S) by MEXT and Japan Society for the Promotion of Science (JSPS).

In addition, Assistant Professor Dr. Okamoto, M. (tenure-track position) with University of California, Riverside and international joint research team discovered a synthetic compound, which can confer drought stress tolerance of plants. It was published in Proc. Natl. Acad. Sci. USA (PNAS) on July 2, 2013.

In February 2014, the Cold and Arid Regions Environmental and Engineering Research Institute of the Chinese

ページ上に公開した。

### 組織・運営体制

本センターは、センター長、副センター長、教授会（教授、准教授等で構成）、運営委員会（外部委員、学内委員、センター専任教授で構成）及び共同研究委員会（外部委員、センター専任教授で構成）、5研究部門、乾燥地植物資源バンク室、及び事務部で組織され、その運営は、教授会と運営委員会によって行われる。なお、鳥取大学技術部は平成24年度より組織が一元化され、1つの部局となったが、これまでと同様、業務依頼及び技術支援による相互連携を図っている。

研究部門は、気候・水資源、生物生産、緑化保全、社会経済、保健医学の5研究部門から構成され、専任の教授5名、准教授5名、助教4名、国内客員3名、外国人客員3名が配置されている（平成26年3月1日時点）。また、平成25年度はプロジェクト研究員12名、日本学術振興会特別研究員1名が配置された。事務系には職員14名（事務職員5名、事務補佐員9名）、技術系には職員9名（技術職員4名、技術補佐員5名）が配置され、研究・教育の支援事務などを担当している。

### 共同研究、教育、刊行物

平成25年度における共同利用研究者（大学教員など）は74名、在籍学生は21名（博士課程4名、修士課程12名、学部学生4名、研究生1名）である。

共同研究に関する研究発表会は毎年開催しており、平成25年度は、12月7日～8日に当センターにおいて開催した。また、センター内外の乾燥地研究者によるセミナーも数多く開催されている。

教育については、2009年度より修士課程（農学研究科）及び博士課程（連合農学研究科）に「国際乾燥地科学専攻」を新設し、学部一修士一博士の一環教育を整備している。

定期刊行物としては、鳥取大学乾燥地研究センター年報を発足以来毎年刊行し、センターの研究教育活動の紹介を行っている。また、平成25年度には、以下の刊行物を出版した。

- Restoration and Development of the Degraded Loess Plateau, China (恒川篤史、劉国彬、山中典和、杜盛 編集、Springer社、平成25年10月出版)
- 乾燥地を救う知恵と技術 砂漠化・土地劣化・干ばつ問題への対処法 (鳥取大学乾燥地研究センター監修、恒川篤史 編集代表、丸善出版、平成26年3月出版)
- モンゴル 黄砂を辿る (鳥取大学乾燥地研究センター監修、鳥取大学黄砂プロジェクト編、今井出版、平成26年3月出版)

### 研修施設

平成23年8月には、学外の共同研究者や学生が研究及び研修のために宿泊できる研修施設（ゲストハウス）が完成。この施設は、ツインルーム2室、シングルルーム4室、研修室1室を備えている。

Academy of Sciences (CAREERI), the College of Pastoral Agriculture Science and Technology of the Lanzhou University (CPAST), and ALRC entered into an agreement titled “Memorandum on Combating Desertification Cooperation Research in Minqin” with the target of zero net rate of land degradation.

And, since March 2014, Associate Professor Kimura, R. has developed his “Monitoring system for Asian dust occurrence in East Asia” on the ALRC’s web site.

### Organization and Management Structure

ALRC consists of the Director, Vice Director, Faculty Meeting, Advisory Committee, Joint Research Committee, Research Division, the Laboratory of Arid Land Plant Resources, and the Administration Department. The Faculty Meeting and the Advisory Committee operate the center. The Technical Departments of Tottori University integrated their organizations in FY 2012 to form one department, but as in the past, maintains mutual links based on business requests and technical support.

The Research Division is composed of five divisions: the Climatology and Water Resources Division, the Biological Production Division, the Afforestation and Land Conservation Division, the Socioeconomics Division and the Health and Medicine Division. As of March 2014, five full-time professors, five associate professors, and four assistant professors, as well as three visiting national professors and three visiting international researchers were allocated to these research divisions. In addition, 12 project researchers and one JSPS fellowship researcher were added to our research teams in FY 2013. Moreover, 14 office staff (five full-time and nine part-time) and nine technical staff (four full-time and five part-time) supported ALRC’s research and education.

### Joint Research, Education, Publication

In FY 2013, 74 joint researchers, mainly from national and private universities, were attached to ALRC. In addition, we had a total of 21 students; four doctoral students, 12 master’s students, four undergraduate students, and one research student.

ALRC holds the Joint Research Symposium every year. In FY 2013, we held the symposium on December 7 and 8 at the center. Seminars were often held by a large number of internal and external experts.

Concerning education, a course named “Global Arid Land Science” was established on FY 2009 for Master’s course (Graduate School of Agriculture) and Doctoral course (United Graduate School of Agricultural Sciences). This course offers a consistent educational system through undergraduate, master’s and doctoral courses.

Annual report has been published since the establishment of ALRC, which provides information and data about our research and education activities.

In addition, ALRC issued the following publications in FY 2013.

- “Restoration and Development of the Degraded Loess Plateau, China” (Editors: A. Tsunekawa, G. Liu, N. Yamanaka, S. Du, Published by Springer, Oct. 2013)
- “Knowledge and Technology to Save Drylands - Solutions to Desertification, Land Degradation and Drought” (Supervision: ALRC, Chief Editor: A. Tsunekawa, Published by Maruzen Publishing Co. Ltd., March 2014)
- Mongolia - a Photobook of the Asian Dust Project (Supervision: ALRC, Editor: Asian Dust Project of Tottori University, Published by Imai Printing, March 2014)

## アウトリーチ活動

乾燥地研究センターでは、国内外や地域の人々にセンターを知ってもらうため、施設見学や体験学習などを積極的に受入れている。また、研究成果を広く社会に還元するため、一般市民や研究者を対象としたシンポジウム、パネル展等のイベントを開催している。

平成 25 年度の主な活動は以下のとおり。

- 黄砂プロジェクト等研究紹介パネル展：平成 25 年 8 月 5 日～8 日、イオンモール鳥取北店（鳥取市）
- 一般公開：平成 25 年 8 月 10 日、参加人数 177 名
- きみもなろう！砂漠博士：平成 25 年 8 月 10 日、参加人数 16 名
- 国連砂漠化対処条約・第 11 回締約国会議（UNCCD/COP 11）への参加、及びサイドイベントにおけるブース展示：平成 25 年 9 月 16 日～27 日、ナミビア共和国・ウィントフック
- 第 44 回日本緑化工学会大会でのセンター活動紹介パネル展：平成 25 年 9 月 27 日～29 日、鳥取大学
- 黄砂プロジェクト写真展、特別ミニ講演会：平成 26 年 2 月 1 日～28 日、鳥取大学医学部附属病院（米子市）



Arid Land Research Center



Arid Land Dome was constructed in 1998 to enhance the efficiency of research at ALRC

## Accommodation Facility

Guest house was built in August 2011, which is available for joint researchers and students who would like to stay ALRC premises for research activities and training. This accommodation facility has two twin rooms, four single rooms and one training room.

## Outreach Activities

ALRC has been conducting various public outreach activities such as facility tours and on-site learning program to promote and publicize ALRC activities both inside and outside Japan. In addition, ALRC has been holding many events such as symposiums and panel exhibitions to disseminate research results and achievements to public and outside researchers.

We held the following activities in FY 2013.

- Exhibit panels on the research of Asian Dust Project (5-8 August 2013, AEON Mall Tottori Kita)
- Open House Event (10 August 2013, ALRC)
- On-site learning program for elementary students “Let’s become a Dr. Desert” (10 August 2013, ALRC)
- Participation in United Nations Convention to Combat Desertification (UNCCD) - 11th Session of the Conference of the Parties (COP 11) (16-27 September 2013, Windhoek, Namibia)
- Panel exhibition on ALRC’s research activities at the 44th Meeting of the Japanese Society of Revegetation Technology (27-29 September 2013, Tottori University)
- Photo exhibition of Asian Dust Project and Special symposium (1-28 February 2014, Tottori University Hospital)



The Director of ALRC took part in the Committee on Science and Technology (CST) meeting at UNCCD COP 11 in Namibia.



Guest House

## (2) 研究部門

### 1) 気候・水資源部門

篠田 雅人 (気候学)

乾燥地における水・エネルギー循環を通じた広域的な気候と陸域生態系（農業生態系も含む）の相互作用を研究している。乾燥地由来の環境問題である黄砂発生過程の研究も行っている。

1. モンゴル草原における干ばつ実験 (図)
2. アジア・アフリカ乾燥地域における陸域生態系による気候メモリの動態 (科研費)
3. モンゴル国における干ばつ・ゾドの早期警戒システムの構築 (JICA プロジェクト) (図)
4. 黄砂発生過程と地表面 (土壌水分・積雪・植生) 状態 (ポスト GCOE プログラム、黄砂プロジェクト)
5. 干ばつに対して脆弱なアジア草原のホットスポットの特定 (科研費)
6. 乾燥地災害学の体系化 (科研費)



Drought experiment with a rain shelter in a Mongolian grassland during the summer of 2005

## (2) Research Divisions

### 1) Climatology and Water Resources Division

Masato Shinoda (Prof., Climatology)

The climatological subdivision conducts research on eco-climate system dynamics in arid region; interaction between the large-scale climate and terrestrial ecosystems (including agricultural ecosystems) through water, energy, and carbon circulation. Focus is placed on climate change analysis in arid region, drought sciences, and early warning system of meteorological disasters. We also promote research on dust emission processes in Mongolia that are linked to the arrival of aeolian dust to Japan. Major study topics are as follows:

1. Drought experiment in a Mongolian grassland (Grants-in-Aid for Scientific Research from the Japanese Ministry of Education, Science, Sports, and Culture) (Fig.)
2. Climate memory dynamics of terrestrial ecosystems over the Asian-African arid region (Grants-in-Aid for Scientific Research from the Japanese Ministry of Education, Science, Sports, and Culture)
3. Developing an early warning system of drought and dzud in Mongolia (JICA project) (Fig.)
4. Developing a biogeophysical model simulating the dust emission processes (the post global center of excellence program for dryland science of Tottori University, Dust project)
5. Identifying hotspots on the Asian steppe that were vulnerable to drought (Grants-in-Aid for Scientific Research)
6. Integrating Dryland Disaster Science (Grants-in-Aid for Scientific Research)



Developing an early warning system of drought and dzud in Mongolia

## 木村 玲二 (気象学)

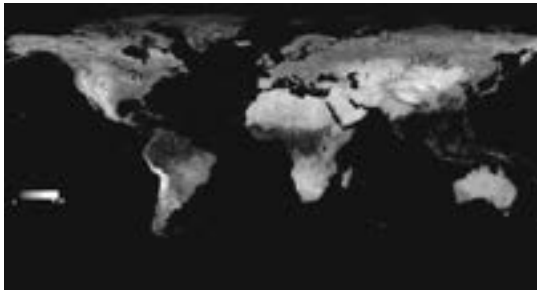
気象学分野では以下のような研究を行っている。

- (1) 乾燥地における熱フラックスの定量的解明
- (2) 気象データとリモートセンシングデータを併用した地表面湿潤度のモニタリングとモデリング
- (3) 北東アジアにおいて植生がダストの発生を抑制する物理的メカニズム

これらの研究は、日本学術振興会による科学研究費(課題番号 25304037, 24510017, 25300001)、文部科学省特別経費事業(黄砂プロジェクト)および JAXA Global Change Observation Mission の援助によって、主として中国やモンゴル、エジプトで行われている。

本年度は、特に以下の研究で成果を得た。

1. 地表面観測衛星によって得られる地表面湿潤度指標 (MTVDI) の適用性を黄砂の発生源である中国・張掖の現場観測値で検証した。MTVDI は、黄砂発生に深く関わる地表面の土壤水分をよく再現しており、衛星マイクロ波放射計による AMSR-E プロダクトと比較しても良好な再現性が確認された。
2. 中国の黄砂発生源の1つである河西回廊(張掖)の草原荒廃地において、熱・水収支の観測、解析を行った。その結果、(1) 観測期間の総蒸発散量は総降水量とほぼ一致した、(2) 群落は浅い層の土壤水分を使って蒸散しており、地表面下の浅い部分に根を水平に張って、効率的に少ない雨を利用していることが示唆された、(3) 群落の水分効率飽和や土壤水分に影響されていることが示唆され、生理的に見ても群落は、乾燥条件下では蒸散を抑制し、降雨後の水分条件が良いときに蒸散を活発に行うことが理解できた。
3. 地表面観測衛星によって得られる昼夜地表面温度と反射率を用いた乾燥度指標 (SbAI) を開発した。SbAI は全球の湿潤度、乾燥度の分布を的確に表現していた。また、SbAI がある値以上になると、黄砂は発生しにくくなると仮定し、北東アジア地域における SbAI の閾値以上の占有率と日本で観測される黄砂発生回数 (ADE) との比較を行った結果、占有率の増加とともに ADE は優位に増加することが認められた。(図参照)
4. 植生、積雪を考慮した北東アジア黄砂発生臨界風速のアルゴリズムを開発し(1日ごとに更新)。さらに16日コンポジット画像も作成)、web 公開システムを構築した。



Spatial distribution of Satellite based Aridity Index (SbAI) in June 2005 using a thermal band of satellite sensor. (Kimura and Moriyama, 2014)

## Reiji Kimura (Assoc. Prof., Meteorology)

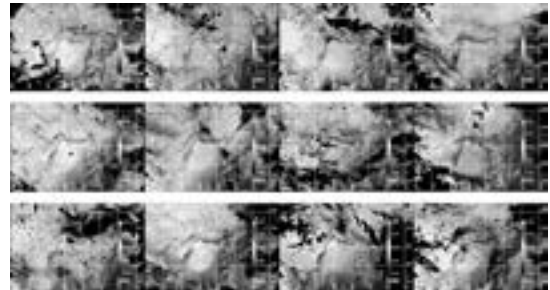
The Meteorology Subdivision conducts research mainly as follows:

- (1) Quantitative analysis of heat fluxes in arid land.
- (2) Monitoring and modeling of surface moisture by combining the meteorological and remote sensing data.
- (3) To make clear the physical mechanism for preventing the dust outbreak by vegetation in northeast Asia.

These studies are conducting under the aid by Japan Society of the Promotion of Science Grants (KAKENHI 25304037, 24510017, 25300001), MEXT Project of Integrated Research (Asian Dust Project), and JAXA Global Observation Mission, especially in China, Mongolia, and Egypt.

In this fiscal year, I obtained results from following researches:

1. A modified temperature-vegetation dryness index (MTVDI) was tested to see if it could reproduce the surface SWC observed in Zhangye, China. A greater correlation is seen between MTVDI and SWC than between SWC from AMSR-E and SWC in Zhangye.
2. Seasonal evapotranspiration was estimated over a degraded *Salsola passerina* patch in the Hexi Corridor, China. Total evapotranspiration during the observational period was 139 mm based on heat-balance analysis and was almost the same as the total rainfall (133 mm). *Salsola passerina* transpired using the soil water content above 10 cm. Most of the root zone existed in the range of 3 to 10 cm. This means that *Salsola passerina* grew its roots horizontally at a shallow depth to utilize the scarce water efficiently. Moisture availability of *Salsola passerina* was affected by the vapor-pressure deficit and soil-water content. *Salsola passerina* likely controls transpiration in dry conditions and transpires actively when water is plentiful after a rainfall.
3. A new satellite-based aridity index using day/night land-surface temperature differences (SbAI) has been developed. The relationship between coverage of satellite-based aridity index (SbAI) values greater than threshold value in the target area (35°N to 45°N and 100°E to 115°E) and Asian dust events over Japan was analyzed for 2000 to 2011. Results indicated that coverage of satellite-based aridity-index values greater than threshold value significantly affects Asian dust events over Japan. (refer to the figure)
4. Algorithm of threshold wind speed over northeast Asia is developed considering the effect of vegetation and snow cover. These are developed for public opening by web system.

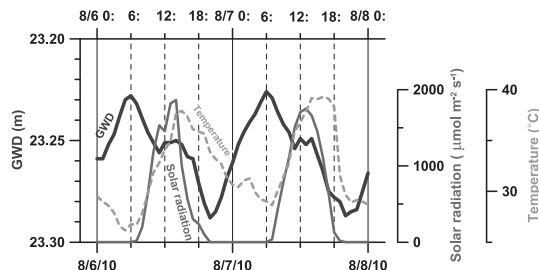


Spatial distribution of SbAI for 2000 to 2011 in the Asian dust source area. Asian dust is easy to occur in the place over threshold value of SbAI. (Kimura and Moriyama, 2014)

**安田 裕 (水文学)**

乾燥地での最大の問題は水がないことである。この乾燥地で極めて重要な水につき研究を行ってきた。

1. 乾燥環境下における外来侵入樹種メスキートと地下水文系との関連。スーダンで現地調査を行い、地下水文系との関連を研究した。日照量最大となる正午前後に、メスキートは midday depression により吸水を低下させていた。このような地下水吸水を、ノン・ダイナミック・モデルであるニューラルネットワークによりシミュレーションを行った。
2. スーダン全土の降雨量時系列につき、全球海面水温度 (Global Sea Surface Temperature: GSST) とのテレコネクションを解明した。大西洋・インド洋の特定海域との間に有意な相関がみられた。このような相関を用いた予測モデルを開発した。
3. 乾燥地の降雨量時系列。スーダンの天水農業地帯であるガダーレフの降雨量時系列解析を行った。NDVI と月雨量にはラグ 2 ヶ月で 0.8 以上の相関があることがわかった。また、積算日雨量により雨季の同定を行った。この手法により同定された雨季は日雨量 5 mm 以上が継続する期間とほぼ同一であった。
4. 鳥取県水田流域の汚濁負荷の出現。鳥取県湖山池にある水田流域で汚濁負荷の変動を観察した。代掻き、田植え、中干しなどの農作業により流出汚濁負荷が大きく変化することが解明された。

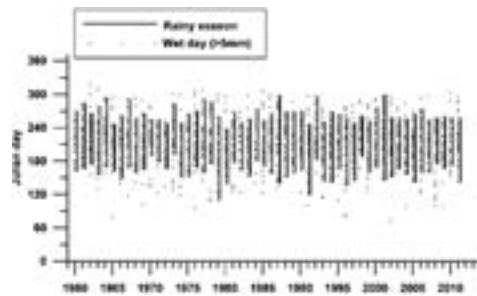


Groundwater uptake by an alien invasive plant, mesquite.

**Hiroshi Yasuda (Assoc. Prof., Hydrology)**

Most serious and basic problem in arid land is water shortage. The sub-division of water resources has worked for water issue in arid environment.

1. Interaction between an invasive alien species, mesquite and subsurface hydrologic environment. Field survey has been performed in Sudan to clarify the interaction. Mesquite ceased groundwater uptake around the noon when solar radiation became the maximum. The cease was caused by the midday depression of mesquite. Numerical simulation model for such a unique groundwater uptake was developed using the neural network model.
2. Teleconnection of rainfall time series over Sudan (Sudan and South Sudan) with global sea surface temperature (GSST) was clarified. There were significant correlations with some sea regions over the Atlantic and Indian Ocean. Rainfall forecasting model was developed by these teleconnections.
3. Identification of the rainy season in arid land. Analysis of rainfall time series of Gadaref, rainfed agriculture area in Sudan was carried out. There was high and significant correlation with lag 2 months between NDVI and monthly rainfall. By accumulating daily rainfall, the rainy season was identified. The identified rainy season coincides with duration of sequent rainfall more than 5 mm.
4. Pollutant runoff from a paddy field basin. Fluctuation of pollutant runoff was observed at a paddy field basin of Koyama lake in Tottori. The result shows that pollutant runoff is subject to agricultural activity such as puddling, planting and beginning of midsummer drainage period.



The rainy season in Gadaref, Sudan was identified.

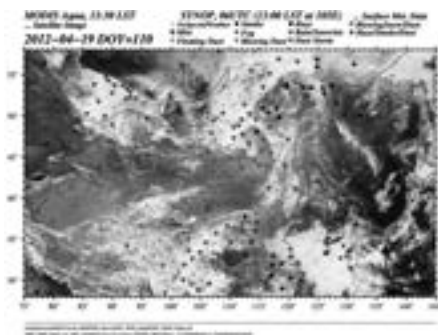
## 黒崎 泰典 (ダスト気候学)

ダスト粒子 (日本では黄砂として知られている細かい土壌鉱物粒子) は乾燥地域や耕作地などにおいて強風によって舞い上がり、より細かい粒子は自由対流圏の風によって長距離輸送される。サハラ砂漠起源のダストはヨーロッパやアメリカ大陸において、ゴビ砂漠やタクラマカン砂漠起源のダストはグリーンランド、ハワイ、米国西海岸などにおいてしばしば観測される。ダストは人間生活に大きく影響しているが、発生域と風下域で影響タイプが異なる。発生域付近では気象災害の側面が強く、人や家畜の死亡・行方不明、建築物損壊などの被害が報告されている。発生地域から遠くなるに従い、健康影響、酸性雨中和、海洋生態系への影響、放射過程・雲凝結過程を介した気候への影響といった環境影響の側面が強くなる。ダスト気候学分野では、(1)日々のダスト空間分布モニタリング、(2)発生原因解明、(3)日本に飛来するダスト(黄砂)の沈着量、発生源解明を課題とし、本年度は以下のことを行った。

課題(1)では、気象台観測データとMODIS衛星画像を用いた東アジア域準リアルタイムダストモニタリングシステムの維持更新を行い、世界各地のダスト研究者とダスト発生・輸送経路の議論を行った。

課題(2)では、「東アジア砂漠化地域における黄砂発生源対策と人間・環境への影響評価」(黄砂プロジェクト)において、2012年3月にゴビ砂漠北部のツォクトオボー(モンゴル)に設置した黄砂発生観測システムの維持管理を行った。観測開始からほぼ1年が経過し、ツォクトオボー内でもダスト発生域が空間的に偏在していることが分かってきたため、地域による黄砂発生量の違いを明らかにするための観測も開始した。

課題(3)では、乾燥地研究センター共同研究「日本における黄砂の沈着量の観測」(代表:長田和雄・名古屋大学)において、ダスト沈着量観測を乾燥地研究センター屋上で実施した。この観測において、課題(1)で作成した衛星画像を観測日特定に活用した。課題(2)(黄砂発生)と課題(1)&(3)(日本への飛来)を繋げるため、乾地研共同研究(代表:関山剛・気象庁気象研究所)において数値モデルを用いた黄砂発生・輸送の研究を開始した。



Dust distribution on April 19, 2012. This image was produced by the near-real time east Asia dust monitoring system

## Yasunori Kurosaki (Assoc. Prof., Dust Climatology)

Mineral dust particles are blown up by a strong wind in arid and agricultural areas, and they are transported over a long distance by wind in free troposphere. We often observe dust particles produced in the Gobi and the Taklimakan travels to Greenland, Hawaii, the North America, etc. Dust largely affects human lives, but types of the effect are different by place. In source areas, it works as disaster which leads death and disappearance, damages on architectural facility, etc. In downwind areas, it works as a factor of health impact such as respiratory disease and as a factor of environment change such as neutralization of acid rain, marine ecosystem change, climate change, etc. The dust climatology subdivision has three subjects, which are (1) monitoring of dust distribution, (2) clarification of dust production causes, and (3) clarification of the amount and the source regions of deposited dust in Japan. I made researches described as below in this fiscal year.

On the subject (1), I maintained the near-real time east Asia dust monitoring system using MODIS satellite images and meteorological observatory data. I made discussions of emission places and transportation routes of dust with researchers in Japan and other nations.

On the subject (2), I maintained a dust emission observation system, which was set up in Tsogt-Ovoo Mongolia located in a northern part of the Gobi Desert under Project Asian Dust by Tottori University on March 2012. About one year has passed since the observation started, and we realized that dust emission areas are unevenly distributed. I therefore started a new observation to clarify the spatial difference of dust emission.

On the subject (3), I made samplings of deposited dust on the roof of ALRC building under an ALRC joint research (PI: Prof. Osada, Nagoya Univ.). I used the dust monitoring system made in the subject (1) to decide sampling dates. To connect subject (2) (dust emissions) and subjects (1) & (3) (dust transports to Japan), I started a study using a numerical dust model under an ALRC joint research (PI: Dr. Sekiyama, Meteorological Research Institute).



Dust emission observation system set up in Tsogt-Ovoo Mongolia located in a northern part of the Gobi Desert.



## 2) 生物生産部門

恒川 篤史 (保全情報学)

保全情報学分野では、乾燥地における植物生産および生態系変化のモニタリングとモデリングを中心的課題としている。特に水やダストを介しての大気と陸域（植生と土壌）の間の相互作用の解明や、乾燥地における生態系・地域社会の持続可能性を評価する手法の開発に力を入れている。そのため数値モデル・リモートセンシング・GISなどの情報技術とフィールドでの観測、乾燥地研究センターにおける施設実験などを組み合わせながら、以下のような研究を進めている。

1. 生態系プロセスモデルを用いた環境応答の予測
2. リモートセンシング・GISを用いた生物生産力の広域推定
3. 乾燥地における持続可能性の評価手法の開発
4. バイオ燃料植物の生産力と環境影響の評価

本年度は、以下の2冊の書籍を出版することができた。

1. Springer社から「Restoration and Development of the Degraded Loess Plateau, China (中国・黄土高原の土地劣化とその修復および開発)」。この書籍は、乾燥地研究センターが中国科学院・水土保持研究所と共同で実施してきた拠点大学交流事業「中国内陸部の砂漠化防止及び開発利用」(2001～2010年度)およびグローバルCOEプログラム「乾燥地科学拠点の世界展開」(2007～2011年度)の成果をとりまとめたものである。
2. 丸善出版から「乾燥地を救う知恵と技術：砂漠化・土地劣化・干ばつ問題への対処法」。この書籍は、グローバルCOEプログラムの成果をもとに、乾燥地における主要な問題である砂漠化・土地劣化・干ばつ問題への対処法、すなわち乾燥地における持続可能な土地管理の方法をまとめている。乾燥地の現状、問題の解説から始まり、土壌・植生の劣化、病気や貧困といった問題を防ぎ、持続可能な生活を維持していくための技術や知恵を25の項目(方法)として紹介している。乾燥地の現場で活躍する技術者、NGO・NPOで実務を担当される方にも読んでいただきたい。



Cover page of "Knowledge and Technology to Save Drylands: Solutions to Desertification, Land Degradation and Drought."

## 2) Biological Production Division

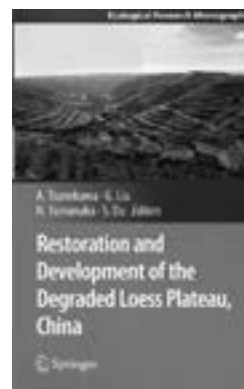
Atsushi Tsunekawa (Prof., Conservation Informatics)

The Conservation Informatics Subdivision conducts research on the monitoring and modeling of the plant production and ecosystem change in the dry lands. Particular efforts are being made to clarify the interaction between the atmosphere and the land surface (vegetation and soil) through water and dust, and to develop methodologies for evaluating the sustainability of ecosystems and local communities in dry lands. The research of the Subdivision is driven by combining the use of information technologies such as numerical modeling, remote sensing and geographic information systems (GIS); field observations; and experiments using ALRC's facilities for the following topics.

1. Prediction of environmental response using a process-based ecosystem model
2. Regional estimation of biological productivity using remote sensing and GIS
3. Development of methodologies for evaluating sustainability in drylands
4. Evaluation of productivity and environmental impacts of biofuel plants

We have published the following two books in the fiscal year 2013:

1. "Restoration and Development of the Degraded Loess Plateau, China" published from Springer, which was edited based on results from collaborative projects between China and Japan, especially from "Researches on Combating Desertification and Developmental Utilization in Inland China" funded by the Core University Program and also supported by Global COE Program. The editors are A. Tsunekawa, G. Liu, N. Yamanaka and S. Du.
2. "Knowledge and Technology to Save Drylands: Solutions to Desertification, Land Degradation and Drought" from Maruzen Publishing Co. Ltd., which was edited based on our past research achievements obtained through Global COE Program and others. The book provides 25 items as interventions against desertification, land degradation and drought (DLDD), which are good examples of practices of sustainable land management (SLM).



Cover page of "Restoration and Development of the Degraded Loess Plateau, China."

## 辻本 壽 (分子育種学)

現在 70 億人の世界人口は 50 年後には 90 億人を上回るが、地球の環境変動下で食糧をいかに増産するかが大問題である。分子育種学分野では、乾燥地において主要作物であるコムギに乾燥耐性、高温耐性等の環境ストレス耐性を付与して安定生産できる品種、さらに水や肥料等の資源の投入を削減し、環境に負荷をかけにくい品種の開発に関連する以下の研究を行っている。

- コムギ近縁野生植物の有用形質の探索
- 異種染色体を保有するコムギ系統の開発
- コムギの環境ストレス耐性および節肥性の選抜
- 品質や栄養価の向上に関するコムギ遺伝子の研究
- 異種およびコムギ染色体の組換えに関する研究
- 種間交雑法および異種染色体同定法の改良
- 緑化植物キリンソウの育種

これらの研究は、中国、モロッコ、チュニジア、スーダン、メキシコ、アフガニスタン、トルコ、日本等の研究者と共同して行った。

本年度は、以下の成果が得られた。

1. 異種染色体添加系統の形質調査：オオハマニンニクの染色体を保有する系統の中に、耐暑性または、アルミニウム毒性に耐性のある系統を見いだした。
2. 選抜集団の開発：タルホコムギのゲノムをもつ合成コムギをパンコムギに交配し、野生種の多様性を含む実用パンコムギの集団を作り、「多重合成コムギ派生系統」と名付けた。これらの集団を、日本、モロッコ、スーダン、チュニジア、トルコおよびアフガニスタンの圃場に播種した。
3. 同祖染色体対合を検出するための系統開発：コムギに 2 種のハマニンニク属植物の染色体を導入し、野生植物とコムギ染色体の組換えに影響する因子を検出するための実験系統と手法を開発した。この実験系を用い、いくつかの因子の効果を調査した。
4. 植物遺伝資源探索：キルギスにおいてコムギおよび近縁野生植物の系統を収集した。また、北極にあるスヴァールバル世界種子貯蔵庫を視察した。



Evaluation of MSD population in ICARDA (Morocco, Mar 5, 2014)

## Hisashi Tsujimoto (Prof., Molecular Breeding)

The world population, currently about 7 billion, will be more than 9 billion after 50 years. Production of food for welfare of the increasing population under changing climate is a high-priority issue. Our research targets the development of high yielding wheat varieties for sustainable production under harsh environmental conditions such as drought, salinity and heat. Additionally, breeding wheat with water-saving and fertilizer-saving traits are also our targets. Followings are the topics of my laboratory.

- Exploration of useful traits of wheat related wild species
- Production of wheat lines possessing alien chromosomes
- Selection of wheat lines showing environmental-stress tolerance and fertilizer-saving traits.
- Studies on wheat gene for improving flour quality and mineral contents
- Exploitation of factors to promote meiotic recombination between wheat and alien chromosomes
- Improvement of efficient methods for both hybridization between wheat and wild relatives, and identification of alien chromosomes introduced to wheat
- Breeding of 'Evergreen Kirinso', an afforestation plant

These researches were conducted in collaboration with my colleagues in China, Morocco, Tunisia, Sudan, Mexico, Afghanistan, Turkey, India, Japan etc.

In this fiscal year, following results were obtained:

1. Evaluation of alien chromosome addition wheat lines: We found wheat lines showing heat stress and aluminum toxicity tolerance.
2. Production of wheat selection population: We crossed the synthetic wheat having the genome of *Aegilops tauschii* and produced wheat populations including intraspecific diversity of the wild species. These breeding materials were named Multiple Synthetic Derivatives (MSD) population' and cultivated in the experimental fields in Japan, Morocco, Sudan, Tunisia, Turkey and Afghanistan.
3. Production of homoeologous recombination indicator: By introduction of two types of *Leymus* chromosomes we obtained wheat lines to indicate homoeologous recombination frequency. Using this material, we analyzed the effects of some possible factors to promote chromosome recombination.
4. Plant explorations: I joined the plant expedition in Kyrgyzstan and collected many accessions of wheat and related species. In addition, I visited Svalbard Global Seed Vault in the Arctic for back-up storage of germ-plasm stocks.



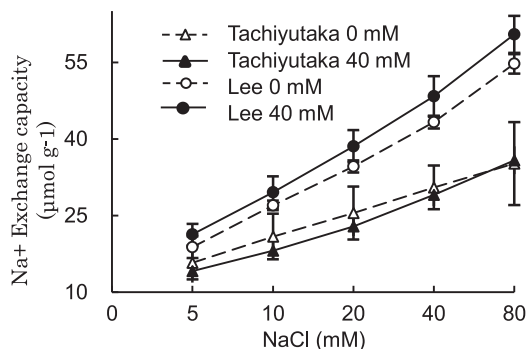
Global Seed Vault for backup system of genetic resources (Norway, Feb 23, 2014)

## 安 萍 (植物生理生態学)

植物生理生態学分野では、乾燥地における植物や作物の生理生態学と適正栽培技術の開発を中心的課題としている。特に、植物と作物の環境ストレス応答とその耐性機構の解明、乾燥地農業における水利用効率向上技術の開発、作物の塩および乾燥ストレス緩和技術の開発などに力を入れている。これらの研究は国内における基礎研究と国外での乾燥地の現場における応用研究を組み合わせた研究を進めている。また、砂漠と砂漠化地域において植物の分布と土壤環境を調査し、分布の特性から植物と土壤との相関関係を解明する研究も重点的に取り組んでいる。この研究は、砂漠及び砂漠化地域の植生回復に相応しい緑化用樹種・草種の選定、栽培方法の確立などの策定に役立ち、さらに、生態系の環境維持に重要な役割を果たす植物や経済的に価値の高い植物を発見した場合、これらの植物の生態生理特性を解明し、農業利用に適切な栽培技術を開発している。具体的には、以下の課題について進めている。

- トマトおよび塩生植物の耐塩性機構の解明
- 作物の根の特性と環境ストレス耐性との関係の解明
- 経済価値の高い塩生植物の栽培技術開発
- 塩水灌漑による栽培技術の開発
- 中国の砂漠における植物の分布調査
- 根の細胞壁の化学的物性特性と作物の耐塩性の関係の解明

本年度、国外での共同研究のため、中国科学院遺伝发育生物学研究所農業資源研究センターを訪問し、国際ワークショップ「植物の環境ストレス耐性と塩性資源の持続的利用」に参加した。その後、中国渤海湾沿岸の塩性土壤を視察し、塩性植物の分布を調査した。また、中国科学院寒区乾区環境と工程研究所を訪問し、日中ワークショップ「民勤オアシスにおける日中共同研究」に参加した。その後、中国甘粛省に位置する民勤オアシスで農業経営、水管理、砂漠緑化などを視察した。中国河北省林業科学院との共同研究「長根苗を利用した砂地での植林技術の開発」および中国科学院植物研究所との共同研究「中国北部における植生と環境との関係の解明」を本年度も引き続き取り組んだ。



Na<sup>+</sup> exchange capacity of the root cell walls of soybean cultivars, Lee and Tachiyutaka, under 0 and 40 mM NaCl treatments.

## Ping An (Assoc. Prof., Plant Eco-physiology)

The Plant Eco-physiology Subdivision conducts researches on the elucidation of eco-physiological characteristics of plants and crops and development of appropriate cultivation technology in arid lands. Particular efforts are being made to clarify the responses of plants and crops to environmental stresses and relevant mechanisms. The purpose of the studies is to develop cultivation technology for enhancement of water use efficiency and mitigation of drought and salinity stresses in dryland agriculture. The studies combined the basic research in Japan using the ALRC's facilities and applied research at real fields in drylands. Besides, plants distributions in deserts and desertified areas are also the focus of the studies. By knowing the interactions of plants and environmental conditions, measures for vegetation recovery in desertified areas would be established. Special plants that have important ecological functions or potentially economic value would be further investigated. The current studies are:

- Salt tolerance mechanisms in tomato and halophytes;
- Relationship between root and plant salt tolerance;
- Development of cultivation techniques of halophytes with high economic value;
- Application of saline water for crop irrigation;
- Vegetation distribution in the desert of China.
- Relationship between the chemical and physical characteristics of root cell wall and salt tolerance in crops.

Overseas research activities during the fiscal year 2013 include two visits to China. One visit was to Center for Agricultural Resources Research of the Institute of Genetics and Developmental Biology, Chinese Academy of Sciences (CAS). This visit was to join an "International Workshop on Mechanisms of Plant Stress Tolerance and Sustainable Use of Saline Resources" and conduct a field survey in the saline areas around Bohai Bay. Another visit was to the Cold and Arid Regions Environmental and Engineering Research Institute, CAS. This visit was to join a Sino-Japan Workshop on "Developing Cooperation and Exchange Program in Minqin" and conduct a field survey in Minqin Oasis of northwest China. The cooperative studies with Hebei Academy of Forestry Science and Institute of Botany of the CAS on re-vegetation in sandy land using long-root seedlings and integrated studies on vegetation-environment relation in north China, respectively, have been continuously conducted.



A desert plant (*Elaeagnus angustifolia*), which has high drought tolerance and economic value, in Minqin Oasis.

### エリタイブ ハボラ E. アミン (生物工学)

水不足、農地不足および気候変動は急速に増加する世界人口に十分な食糧を保障するための主たる課題である。

バイオテクノロジーは作物生産量を増加させ環境ストレスによる不適な生育条件による損失を防ぐための最も有用な解決策である。生物工学分野では乾燥や塩等の非生物的ストレス耐性のための植物分子生物学および遺伝子工学の研究を行っている。その目的は乾燥地でのストレス環境下での農作物の適応力を高め、安定した生産性を保障し、土地と水の利用効率を高めることである。

生物工学分野は次の3つの課題解決のため、遺伝子や染色体レベルでの高度な技術を用いて研究を行っている。

1. 乾燥地の環境、特に干ばつ、高温および塩害に適応する新奇遺伝子および遺伝子ネットワークの同定
2. 遺伝子工学によるストレス耐性および高度適応性遺伝子組換え植物の作成。
3. 栽培種および近縁野生種に由来する育種素材の評価

ここでは、重要作物である、ジャガイモ (*Solanum tuberosum*)、イネ (*Oryza sativa*)、コムギ (*Triticum aestivum*) およびそれらの野生植物を研究材料として用いている。また、タバコやシロイヌナズナ等のモデル植物を新奇ストレス耐性遺伝子の試験をするために利用している。

本年度、私達は、植物細胞中の活性酸素量の増加時に機能する3つの異なる遺伝子を保有する形質転換植物を育成した。さらに本分野では、本年度は博士課程、修士課程学生および研修生の指導も行った。

海外での活動として本年度は、オーストラリアでの国際会議に参加し、またスーダンでの研究調査を行った。



Preliminary trails of transgenic model plants (tobacco) under fully controlled conditions.

### Eltayeb Habora E. Amin (Assist. Prof., Biotechnology)

Water scarcity, diminishing agricultural lands and climate change are the major challenges to secure enough food for the rapidly increasing world population.

Biotechnology is one of the most viable solutions to increase crop productivity and reduce losses due to unfavorable growth and environmental stresses. The Biotechnology Subdivision conducts research on plant genetic engineering and molecular biology to improve the tolerance to drought, salinity and other abiotic stresses. The aim is to enhance adaptation of agricultural crops to the dryland's stressful environments, assure yield stability and increase land and water resources use efficiencies.

Biotechnology Subdivision adopts advance technologies that operate at the gene level to fulfill following three goals:

1. Identification of novel gene and genetic networks for adaptation to drylands environments, particularly drought, heat or salt affected lands.
2. Genetic engineering of plants with greater adaptation and high tolerance to drought and salinity stresses.
3. Evaluation of breeding materials derived from cultivated and wild relatives of wheat crop.

I carry research on important cultivated crops such as potato (*Solanum tuberosum*), rice (*Oryza sativa*) and wheat (*Triticum aestivum*) and its wild relative species. I also use model plants such as Tobacco and Arabidopsis for testing new stress tolerance genes.

During this fiscal year, we produced transgenic plants engineered with three different genes that functions in increasing the antioxidant contents in plant cells. Currently, these plants are being analysed under different abiotic stresses. Additionally, biotechnology subdivision has contributed to supervise the research of Ph.D. and M.Sc. graduate students, and train international trainees.

Oversea activities during the fiscal year included the participation on international conferences in Australia, and research survey visit to Sudan.



Training international trainees on advanced methods of molecular breeding and biotechnology

## 岡本 昌憲 (植物分子生物学)

陸上植物は動物と異なり、いったん発芽してしまうと、環境が悪化しても違う場所へ移動することができない。そのため、植物には様々な環境ストレス（乾燥、高塩、高温、低温ストレスなど）に対する防御システムを備えている。当研究室では、モデル植物であるシロイヌナズナや重要作物であるコムギ等を用いて、ストレス耐性の分子機構を様々な実験手法を駆使して解明することを目標としている。得られた知見を乾燥地における栽培作物に応用し、作物のストレス耐性向上に結び付けられるように多角的なアプローチをとって研究を進めている。現在、以下に示す研究を進めている。

- 乾燥ストレス耐性を向上させる化合物の探索とその応用
- 選択的 ABA アゴニストを用いた化学遺伝学的手法による ABA 受容体の機能解析
- 選択的 ABA アゴニストを用いた新奇 ABA シグナル因子の探索
- ストレス環境下における mRNA 代謝制御の分子生理学的解析
- ストレス環境下におけるアントシアニン・フラボノイド生合成制御因子の分子生理学的解析
- 遺伝子として未登録の領域に存在するスモールペプチド (sORF) の機能解析
- ABA 受容体を利用した乾燥耐性作物の創出
- 合成コムギ系統からの乾燥・高塩ストレス耐性系統の選抜と分子生理学的解析

これらの研究は、カリフォルニア大学リバーサイド校、トロント大学、理研、九州工業大学、静岡大学などの研究機関と共同で行っている。本年度は以下に示す成果を得た。

1. 植物の乾燥ストレス耐性を向上させる化合物を発見し、キナバクチンと名付けた。
2. 分子生物学的解析から、キナバクチンは ABA 受容体に結合し、ABA のシグナルを ON にして、ストレス耐性を向上させていることが明らかとなった。



Quinabactin binds to ABA receptor and elicits ABA action in plants.

## Masanori Okamoto (Assist. Prof., Plant Molecular Biology)

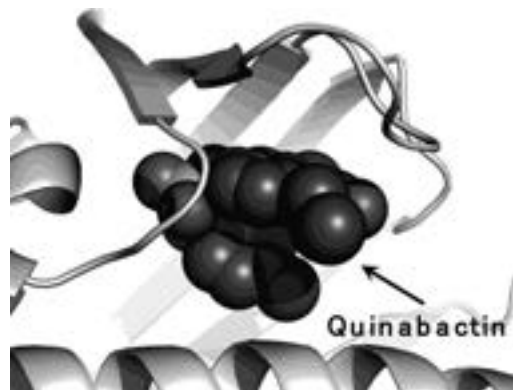
Higher plants are sessile organisms. Therefore, plants have complex defense system for various environmental stresses (cold, drought, heat and high salt stresses). In our laboratory, main goal is to elucidate molecular mechanism for stress responses using Arabidopsis or wheat as plant materials. Additionally, our task is that given knowledge applies to cultivated crops in semi-arid land region in order to develop stress tolerant crops. We are conducting research with multiple approaches using molecular biology, biochemistry, genetics and physiology. The followings are current main researches in our laboratory.

- Screening and application of agrochemical that controls drought stress tolerance.
- Functional analysis of abscisic acid (ABA) receptors by selective ABA agonist.
- Identification of novel ABA signaling mutants by chemical genetic screening.
- Molecular and physiological analysis of mRNA metabolic proteins in response to heat stress.
- Molecular and physiological analysis of key factor for anthocyanin biosynthesis under the drought stress.
- Functional analysis of small open reading frames (sORFs; 30-100 amino acids), which exist in the intergenic region.
- Generation of drought tolerant wheat by using ABA receptor.

These researches are being conducted with UC Riverside, Toronto University, RIKEN, Kyushu Institute of Technology and Shizuoka University.

The followings are highlights in this fiscal year.

1. Novel ABA agonist named as quinabactin was identified by chemical screen. Quinabactin treatments elicited guard cell closure, suppressed water loss, and promoted drought tolerance in adult Arabidopsis and soybean plants.
2. Quinabactin bound in ABA receptor's ligand binding pocket and induced a closed gate arrangement, which is required to elicit ABA action in plants.



Quinabactin treatment confers drought stress tolerance in soybean.

### 3) 緑化保全部門

#### 山中 典和 (緑化学)

緑化学分野では植物生態学に基礎をおいた乾燥地域の緑化及び砂漠化土地の生態系修復に関する研究を行っている。主要な研究テーマは以下の様である。

- 乾燥地における植物群落の生態学的研究
- 樹木の耐乾・耐塩性に関する生理生態学的研究
- 乾燥地の生態系修復に関する研究

これらの研究は、中国、モンゴル、アメリカ等にある研究機関、および国内の大学・研究機関との共同研究で行っている

本年度は、特に以下の研究で成果を得た。

1. 東アジア砂漠化地域における黄砂発生源対策と人間・環境への影響評価 (黄砂プロジェクト; 文部科学省特別経費): 中国内モンゴルクブチ砂漠において、砂丘固定に利用されるヤナギ科樹木の小葉楊 (*Populus simonii*)、銀白楊 (*P. alba*) および早柳 (*Salix matsudana*) について、埋砂が成長や生理に及ぼす影響を明らかにした。
2. 北東アジアの乾燥地生態系における生物多様性と遊牧の持続性についての研究 (環境省環境研究総合推進費): モンゴル国マンダラゴビ地域での “key-resources” 群落優占種についてストレス実験をおこない、多年生イネ科草本の *Achnatherum splendens* については、塩性条件下で、グリシンベタインが最も重要な適合溶質であることを明らかにした。
3. 海水による冠水が東日本太平洋沿岸域に分布する樹種の生理・生存におよぼす影響: アジア熱帯地域原産のホウライチクに着目して海水による土壌冠水実験を行った。冠水時間が 24, 48, 72 時間の冠水処理区と対照区を設定し、冠水後は経時的に個体の生存、葉の変色割合、葉数および Fv/Fm 比を測定した。結果として、冠水時間が長くなるほど影響は大きかったが、24 時間と 48 時間の冠水では枯死した個体はなく、ホウライチクは海水による土壌冠水に対して強い耐性を示した。
4. 二国間交流事業/セミナー (日本学術振興会): 11 月 5 日に韓国ソウルの東国大学にて “the International symposium to Combat desertification in Northern Asia” を共催した。



Experiment on salt tolerance of *Bambusa multiplex*

### 3) Afforestation and Land Conservation Division Norikazu Yamanaka (Prof., Revegetation Science)

The Revegetation science subdivision conducts research on the revegetation in arid areas and ecosystem restoration of desertified lands based on plant ecology. Main research topics of revegetation science subdivision are as follows.

- Ecological studies on plant communities in arid lands
- Eco-physiological studies on drought and salt tolerance of woody plants
- Studies on the ecosystem restoration in arid lands

These researches are being conducted in overseas research institutions in China, Mongolia, USA etc. and those in Japan.

In this fiscal year, I obtained results from following researches:

1. Assessment and Control of Dust Emission in Degraded Drylands of East Asia (Project Asian Dust, Special Project Expenses by MEXT): We elucidated the effects of sand burial on growth and physiology of three Salicaceae trees (*Populus simonii*, *P. alba*, *Salix matsudana*), which are frequently used for sand stabilization in Kubuqi desert, Inner Mongolia of China
2. Biodiversity of dryland ecosystem and sustainability of nomadic production in Northeast Asia (Environment Research and Technology Development Fund, Ministry of the Environment): Stress experiments using “key-resources” species in dry areas of Mongolia were conducted. We elucidated that Glycine betaine is the most important osmolyte of *Achnatherum splendens* under saline conditions.
3. Effects of sea-water flooding on physiology and survival of woody plants distributed along the coastal area of the Pacific Ocean in eastern Japan: Soil of potted *Bambusa multiplex*, which is native to tropical Asia, were flooded by sea water for 0 hr, 24 hr, 48 hr and 72 hr, and changes in plant survival, leaf color, leaf number and Fv/Fm ratio were investigated. The results showed that damages by sea water flooding were increased with increasing flooding period. However, no dead plants were observed in 24 hr and 48 hr sea water flooding. These results indicated that *B. multiplex* was tolerant to short term sea water flooding.
4. Joint seminar under the Japan - Korea basic scientific cooperation program for FY 2013(JSPS): We co-organized “the International symposium to Combat desertification in Northern Asia” at Dongguk University of Seoul, Korea on Nov. 5th.



The International symposium to combat desertification in Northern Asia at Seoul, Korea

## 藤巻 晴行 (土壤保全学)

土壤保全学分野では、乾燥地・半乾燥地における塩類集積の数値予測と土壤劣化(土壤侵食、塩類集積)の防止と修復を中心的な研究課題としている。塩類集積の防止および修復には水の確保が要であるため、節水灌漑や排水の再利用に関する研究にも注力している。昨年度は、主として以下の研究に取り組んだ

- 1) JST-JICA 地球規模課題対応国際科学技術協力事業 (SATREPS)「ナイル流域における食糧・燃料の持続的生産」に係る研究活動
- 2) 植物の生長モデルと天気予報を用いた灌漑水量の決定

1)については、節水策の評価のための大面積圃場実験、農業排水を利用したバイオ燃料生産実験、暗渠排水システムの評価に関する調査活動などに取り組んだ。

2)については、センター内砂地圃場でトウモロコシを用いた栽培実験を行った。2次元の点滴灌漑水量決定シミュレーションモデル WASH\_2D を実験に適用した。この灌漑水量の決定方法に関する解説文(アメリカ土壤学会発行)の執筆を行い、成果の社会還元を図った。

また、以下の海外活動を行った。

1. 「ナイル流域における食糧・燃料の持続的生産」の遂行のための6回、のべ55日のエジプト出張
2. 科学研究費補助金A「灌漑管理統合評価指標の開発～改めて「良い灌漑とは? (代表: 渡邊京大教授)」のためのエジプト出張(6月)
3. 国際共同研究の可能性をさぐるためのパレスチナ出張(5月と8月)
4. 天水田の生産性を向上する方法および乾季畑作における灌漑の必要性を評価するためのラオス出張(7月、11月、2月)(国際農林水産業研究センタープログラム「インドシナ農山村における農家経済の持続的安定性の確立と自立度向上」の依頼出張)
5. 中国科学院寒区旱区環境与工程研究所でのワークショップへの参加と民勤オアシスの現場視察のための中国出張(12月)
6. 科学研究費補助金A「国際河川・青ナイル川流域における土壤侵食・土壤流亡緩和のための土地管理(代表: 恒川センター長)」のキックオフミーティングと観測サイト候補地視察のためのエチオピア出張(2月)



Sugarbeet irrigated with drip irrigation (Sakha, Egypt, February)

## Haruyuki Fujimaki (Prof., Soil Conservation)

The subdivision of soil conservation studies on the prediction of salt accumulation and soil erosion and development of methods to prevent and remedy soil degradation in arid regions. Studies for water saving in irrigation and reuse of wastewater are also being carried out, since water is required for removing excess salts.

The main research activities in the fiscal year were as follows:

- 1) JST-JICA project (SATREPS), "Sustainable systems for food and bio-energy production with water-saving irrigation in the Egyptian Nile basin"
- 2) Determination of irrigation depths using a numerical model and quantitative weather forecast.

Regarding to 1), i) large scale field experiment for evaluation of water saving methods, ii) cropping experiment for production of biofuel using agricultural drainage water, and iii) investigation for evaluation of tile drainage system were mainly carried out.

I performed a field experiment in ALRC for topic 2. Two dimensional simulation model for determining irrigation depth of drip irrigation, WASH\_2D, was applied to the experiment. I wrote an article about the new scheme for determining irrigation depth in a book to be published in 2014.

Overseas research activities during the fiscal year were:

1. visits to Egypt for "Sustainable systems for food and bio-energy production with water-saving irrigation in the Egyptian Nile basin" for 55 days in total 6 times
2. visits to Egypt in June for JSPS Grant-in-Aid for Scientific Researcher "Development of Integrated Indices on Water Management Performance for Wise Irrigation".
3. visits to Palestine in May and August to explore the possibility of joint research program.
4. visits to Lao in July, November and February to evaluate new method to improve productivity of rain-fed paddy rice and necessity of irrigation in upland cropping during dry season.
5. visit to China in December to attend workshop in CAREERI and site visit in Minqin oasis.
6. visit to Ethiopia in February to attend kickoff workshop for JSPS Grant-in-Aid for Scientific Researcher "Land management for mitigating soil erosion and sedimentation in an international river, Blue Nile".



Experimental site in Lao. Soybean was the only crop survived under rain-fed cultivation (February)

### 伊藤 健彦 (動物生態学)

動物生態学分野では、乾燥地に生息する動物の生態学および生態系や生物多様性の保全を中心的課題としている。特にモウコガゼルやアジアノロバなどの中央アジアに生息する大型野生草食動物の生態学的・保全学的研究に力を入れている。衛星追跡や衛星画像解析、地理情報システム (GIS)、現地環境調査等を組み合わせて、大型野生動物の長距離移動の実態や移動・生息地選択要因の解明、野生動物への気象条件の年変動や、人工構造物の影響の評価等を行っている。

本年度はモンゴルの野生哺乳類の大移動に関するプロジェクトを中心に研究を遂行した。本プロジェクトの目的は大規模鉱山開発に伴う新規道路・鉄道建設前の野生有蹄類の生息地利用を把握し、建設後の影響評価をおこなうことである。2013年9月には、モンゴル南部でモウコガゼルの捕獲と衛星追跡開始に成功した。

本年度は特に以下の研究で成果を得た。

1. 環境条件の年変動がモウコガゼルの季節行動圏に及ぼす影響：干ばつや積雪に対応し、モウコガゼルは季節行動圏の位置を年によって変えることを明らかにした。
2. 市街地がモウコガゼルの生息地選択に及ぼす影響：衛星追跡とGIS解析により、モウコガゼルは市街地だけでなく、その周辺部の草原での選択性が低く、負の選択性を示す距離は市街地範囲の数倍から数十倍に及ぶことを示した。
3. モウコガゼルの移動パターンと環境条件の関係：多個体のモウコガゼルの移動パターンを解析し、季節移動距離や定住期間には植生条件の不均一性などが影響していることを示した。



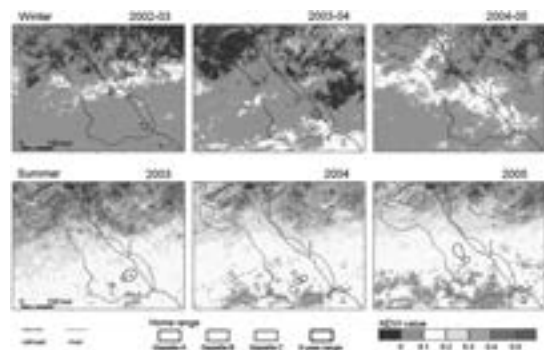
Mongolian gazelles released after a GPS satellite collar was attached

### Takehiko Ito (Assist. Prof., Animal Ecology)

The Animal Ecology Subdivision conducts research on the ecology of wild animals and conservation of ecosystem and biodiversity in drylands. Main targets are ecological and conservational study on wild large herbivores, such as Asiatic wild ass and Mongolian gazelle, inhabiting central Asia. We use satellite tracking to describe their long distance movements, and combine the use of remote sensing, geographic information systems (GIS), and field observations to analyze factors of their habitat selection and movement, and influences of climate fluctuation and artificial constructions on them.

We conducted a project on conservation of great migration of wild mammals in Mongolia in the fiscal year. The objectives of the project are to examine current habitat use of wild ungulates before the construction of new roads and railroads to permit big mining project and to evaluate influences of such new structures on them. We succeeded to start satellite tracking of Mongolian gazelles in September in south Mongolia. In the fiscal year, we obtained and published results on the following researches:

1. Effects of interannual variation of environmental conditions on Mongolian gazelles: Mongolian gazelles changed their seasonal ranges interannually, corresponding to environmental conditions such as drought and snow cover.
2. Influence of urban areas on habitat selection of Mongolian gazelles: We showed negative selectivity by Mongolian gazelles on grassland around urban areas in Mongolia, and the distances avoided were much longer than the ranges of urban areas, by using satellite tracking and GIS.
3. Relationship between movement pattern of Mongolian gazelles and environmental conditions: We showed that heterogeneity of plant availability was an important factor affecting on the movement distance and resident period of gazelles.



Seasonal ranges of tracked Mongolian gazelles and NDVI maps for winter and summer (Ito et al. 2013, J. Arid Environ.)



**谷口 武士 (微生物生態学)**

微生物はマイクロレベルの非常に小さい生物であるが、地球上のバイオマスや機能としては非常に大きく、グローバルスケールでの炭素や窒素の動態にも深く関与している。また、植物の定着や土壌の形成に大きな役割を果たす微生物も存在するため、これらの微生物の役割を解明し、乾燥地の環境修復への利用に関する研究を行うことは非常に重要である。このような背景から、微生物生態学分野では、主に乾燥地の環境修復への微生物利用を目指して研究を行っている。また、ミクروسケールからマクロスケールの様々な規模で観察される現象や問題の解明、あるいは解決に向けて、微生物（細菌や菌類など）に着目した研究を行っている。

主な研究テーマは下記の通りである。

- ストレス条件下における植物—微生物共生関係の解明と環境修復への利用
- ストレス条件下で植物に有用な複合微生物系の探索
- 黄砂発生源地域における菌根菌の土壌団粒形成
- 乾燥地における微生物バイオマスと土壌呼吸の関係

これらのテーマについて、アメリカ、中国、モンゴルを中心に共同研究を行っている。

本年度は主に以下の研究で成果を得た。

1. 中国クブチ砂漠で生育する緑化樹木3種（小葉楊、沙柳、羊柴）の共生菌、および土壌のグロマリン蓄積に関する調査を行った (Fig.)。この結果、小葉楊と羊柴ではアーバスキュラー菌根菌が優占し、沙柳では外生菌根菌が優占していた (Fig.)。グロマリン蓄積は、根の分布と一致する傾向が認められた。
2. モンゴル中部～南部の黄砂発生源地域の土壌微生物相に関する調査を行った。植生が明らかに異なる場所では微生物相の違いが認められたが、その他の地点間では微生物相が類似していた。この原因として頻発する砂塵嵐の影響が考えられる。



Kubuqi desert, Inner Mongolia, China

**Takeshi Taniguchi (Assist. Prof., Microbial Ecology)**

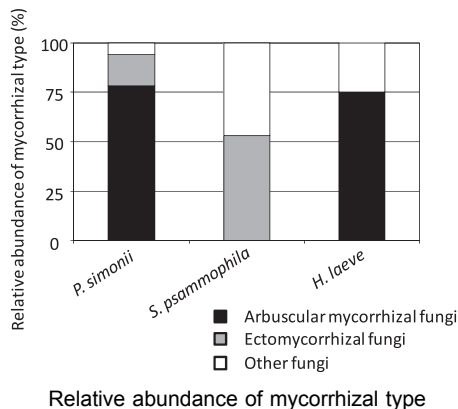
Microorganisms are micro-level and very small organisms, but the biomass and function on earth is extremely large and strongly affects the carbon and nitrogen cycling on the globe. Some microorganisms are also very important for ecosystem restoration in arid regions because they have roles for the enhancement of the establishment or stress tolerance of plants and the improvement and stabilization of soil. My laboratory mainly studies about the ecosystem restoration with microorganisms. In addition my laboratory focuses on the various scale of phenomenon and problems in arid region ranged from micro- to macro-scale and aims to reveal or solve them via microorganisms such as bacteria and fungi. Followings are the topics of my laboratory.

- Plant-microorganism symbiotic relationship under stressful conditions and the application to ecosystem restoration
- Exploration of useful microorganism composition for plants under stressful conditions
- Formation of soil aggregates by mycorrhizal fungi in the source region of Asian dust
- Relationship between microbial biomass and soil respiration in arid regions

These researches are collaboratively conducted with overseas research institutes mainly in the United States, China, and Mongolia.

In this fiscal year, I obtained results from following researches:

1. Mycorrhizal type and glomalin accumulation of three tree species (*Populus simonii*, *Salix psammophila*, *Hedysarum laeve*) were examined in Kubuqi desert, Inner Mongolia, China (Fig). As the result, arbuscular mycorrhizal fungi was dominant mycorrhizal fungi of *P. simonii* and *H. laeve*, whereas ectomycorrhizal fungi was dominant mycorrhizal fungi of *S. psammophila* (Fig). Glomalin accumulation tended to corresponded to the distribution of roots.
2. Soil bacterial community of an Asian dust source region in Mongolia was examined. Soil bacterial community was different at the site with different vegetation type, but the other sites have similar community structure. It indicates that the soil bacteria in this region was mixed by frequent dust storm and the bacterial community was similar among the regions.



### 井上 光弘 (土地保全学)

乾燥地における土壤劣化 (土壤侵食, 塩類集積) の軽減と, 持続的農業のための適切な土壤・水管理の開発を中心的な課題としている。特に乾燥地の砂漠化防止のための土地保全に関する技術開発に力を入れている。

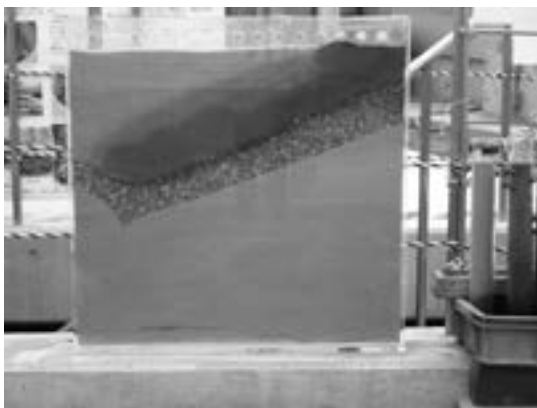
最近の主な研究課題は,

- (1) 誘電率水分計の塩依存性の検討
- (2) 塩水灌漑下の作物生産に及ぼす土壤改良材の効果
- (3) 地中点滴灌漑による野菜節水栽培
- (4) リサイクル資材を用いた省力型節水灌漑法の開発
- (5) 乾燥地の土壤物理特性の決定

本年度は、以下に示した共同研究を行った。

1. 砂漠緑化のための太陽光・風力併用発電を用いた海水揚水・灌漑水生成システムを構築した。
2. 土のキャピラリーバリアを利用した根群域の保水性向上と地下水からの塩水侵入阻止に関する数値計算を試みた。
3. 乾燥地深層地盤における水分塩分挙動に関する新しい観測技術が導入された。
4. 自然熱エネルギー利用による根域加温と有機物施用による低コスト高品質野菜栽培砂ベッドシステムを開発した。

これらの研究内容を学会で口頭発表し、これまでの研究成果を共同研究者と協議して国際誌などに公開した。



Demonstration of water harvesting technology using two dimensional capillary barrier.

### Mitsuhiro Inoue (Specially Appointed Prof., Land Conservation)

Our central challenges are research on the reduction of soil degradation (soil erosion and salt accumulation), and on developing optimal soil and water management for sustainable agriculture in dryland. Particular efforts are being made to develop a proper technology for the land conservation to prevent soil degradation.

Recent main research topics were

- (1) Evaluation of salinity dependence effect on measurement of soil water content using dielectric moisture sensor
- (2) Effect of soil amendments on crop production under saline water irrigation
- (3) Water-saving vegetable cultivation using subsurface drip irrigation
- (4) Development of labor-saving and water-saving irrigation using recycled products
- (5) Determination of soil physical properties in arid regions.

In this fiscal year, following joint researches were conducted.

1. Seawater pumping and irrigation water making system using solar and wind power for greening the desert was constructed.
2. Numerical simulation on the enhancement of soil water retention capacity in root zone and interception of upward saline water from groundwater with capillary barrier was tried.
3. New monitoring technique of soil water and solute transport in deeper vadose zone in dryland was introduced.
4. Sand-bed system for high quality vegetable cultivation with low cost using heating root zone by natural heat energy and manure fertilization was developed.

These research results were reported in same oral presentations in society and published in international journal by discussion with joint researchers



Development of sand-bed system for high quality vegetable cultivation using heating root zone.

#### 4) 社会経済部門

##### 鍋田 肇 (国際開発協力)

畜産： 砂漠化は、国連環境開発会議（1992）で砂漠化対処条約（UNCCD）が協議されたように、開発と環境の調和を命題とする地球規模課題である。砂漠化は、乾燥地での土地劣化の問題と定義されるが、「過放牧（over-grazing）」を原因の第一とする報告が多い。一方、世界の畜産物は、圧倒的に先進国の消費が多く、「過放牧」による砂漠化も、先進国と途上国の集約的生産システム（伝統的ではなく）から多く報告される。

乾燥地では、水の制約から農耕が困難だが、人間が利用できない植生を家畜に食べさせミルク等を人間が利用しつつ移動する遊牧的な生計が、広く持続的に営まれてきた。これが過剰な環境負荷を与えるようになるには、都市人口を支える農耕との競合など様々な社会経済的要因が影響している。この観点から、「過放牧」を砂漠化の主犯とする見方は、否定できないまでも、現実を正確且つ客観的に表現できていない。

社会経済部門では、乾燥地での家畜生産システムの変遷の分析と地域人口が増え続ける中で持続的畜産システムを如何に定義すべきかを研究課題としている。

国際協力／人材育成： 乾燥地農業が直面する課題への対処には、持続的方法で土地と水資源を利用する知識と技術の普及が重要であり、鳥取大学では、乾燥地の国から多くの JICA 技術研修員を受け入れている。

研修参加者は、帰国後、習得技術の実践に努めるが、自国に類似事業の経験者が複数いる場合や当該技術を扱うプロジェクトが稼働中の場合に普及し易い、帰国後一定期間を経ると研修効果は測定できない等が分かって来た。帰国直後の横の連携構築が重要と示唆するものである。技術研修の効果増大の方策は今後も重要課題であり、引き続き研究していく。

国際協力／乾燥地の開発： 乾燥地科学（Dry-land Science）は、乾燥地開発（Dry-land Development）に貢献することが必然的に求められる。上記技術研修へのパレスチナからの参加（2004-05）に加え、パレスチナ大使による乾燥地研究センター訪問（2012）、JICA からの協力要請（2013）等を受け、センターでは、パレスチナの農業研究者との協力関係を構築している。平成 25 年度は、社会経済部門からも同イニシアチブに参加し、先方の課題と取り組みについて理解するとともに、共同研究の可能性を協議した。



A team of ALRC researchers visited National Agricultural Research Center (NARC) of Palestine to discuss collaborative research opportunities.

#### 4) Socioeconomics Division

##### Hajime Nabeta (Assoc. Prof., International Development Cooperation)

Livestock systems: Desertification was intensively discussed at the Rio Conference in 1992; it constitutes a long-term issue of global scale and requires wisdom to harmonize the environment and development. Desertification is defined as land-degradation in the dry environment, and “over-grazing” is often attributed to its foremost cause. However, consumption of livestock products is more in the developed world, and desertification is more reported from the intensive production systems (not the traditional) in the developed and developing countries.

While crop cultivation is constrained in the dry-lands due to limited water, traditional ways of living have long made best use of the dry environment where scarce vegetation is eaten by livestock and human derive foods like milk from them. Thus, designating “over-grazing” as the main offender of the case involves a certain degree of over simplification.

Socio-economics division conducts research to best describe the phenomena and propose sustainable livestock production systems that supports all regional populations.

Overseas cooperation in human resource development: Disseminating technologies for sustainable land and water management is an important part of coping with challenges of dry-land agriculture; Tottori University has been receiving many overseas participants in the technical training course managed jointly with JICA. Ex-participants try to apply gained knowledge back in their countries. Findings of follow-up studies include, new concepts spread with relative ease when like-minded colleagues are near-by, projects of a similar objective are on-going, after some time, and to identify training effects becomes difficult; these all suggest the importance of additional support to link ex-participants right after the training. Research will be continued into identifying factors to improve efficacy of technical trainings.

Overseas cooperation in dry-land development: Dry-land science and dry-land development should go side by side. A visit of Palestinian ambassador on ALRC in 2012 and request from JICA in 2013 for collaboration led to ALRC's efforts to establish collaborative ties with agricultural researchers in Palestine. In JFY 2013, socio-economic division took part in this initiative in understanding challenges and opportunities for future joint research.



Rural residents of Kassala State of Sudan earn their living mainly from livestock, sorghum, and sending their sons to towns for wages.

### (3) 外国人客員研究員/Visiting International Researchers

#### Tsegaye, Enyew Adgo (Assoc. Prof., Soil Science)

October 2012–September 2013

Title: Soil and water conservation in farmland of Ethiopia

Land degradation poses serious challenges to Ethiopian and neighbouring countries such as Sudan and Egypt. Soil erosion by water is the major form of land degradation, challenges millions of subsistence farmers and hampered food production, ecosystem integrity and thus aggravates the extent of poverty in the country. Estimated rates of soil erosion from cultivated lands can reach up to 300 tonnes per ha which is more than 40 times of the rate of soil formation. Poor land management, high population and livestock pressure and subsequent cultivation of marginal lands and overgrazing are major drivers of soil erosion. At the same time, efforts are being done to curb the problem by mobilizing millions of farmers every year to conserve land and water through different soil water conservation (SWC) measures. Achievements of such massive efforts are mixed. Sustainability of the land management activities through mass mobilization are concern of many scholars and always a debate of scientific fora. Improving scientific understanding of land and water resources including socioeconomic realities thus helps to effectively manage the resources. My research at ALRC is assumed to contribute to this broad development goals.

The main specific tasks during the period include:

Publication of scientific papers including follow up, analyse, write up and /or finalization of papers dealing with different aspects of land and water management aspects,

Initiating a joint research project that could be implemented in Ethiopia in collaboration with Bahir Dar University

Involving in research undertakings

Participating in Plant Production Division and ALRC seminars and including in monthly regular meetings of the Division of Plant Production.

Details of the above activities are described below:

#### 1. Developing a joint project

With staff members of the Plant Production Division (Drs Tsubo Mitsuru, Nigussie Haregewoyn, Dereje Meshesha) we managed to develop and submit a joint research project between Tottori and Bahir Dar Universities that would be implemented in the Blue Nile basin in Ethiopia. The project entitled 'Developing multi-criteria decision support system for sustainable management of land and water allocation in the Upper Blue Nile basin' aims at quantifying impacts of sustainable land management initiatives of Ethiopia on land resource conservation and productivity and ecosystems functions in Ethiopia. Investigating effects of such interventions in Ethiopian as well on downstream users such as Sudan and Egypt help to understand not only to fine land management interventions but also cross boarder impacts of such interventions. The project has been submitted to the Japanese Society for the Promotion of Science (JSPS). During the compilation of this annual report, it has been already known that the project has been accepted and a launching workshop (kick-off workshop) is planned to be organized on February 3, 2013 in Bahir Dar, Ethiopia. Therefore, the stay at ALRC of Tottori University could be seen is very productive that has led to further collaboration between the two universities and so will promote in exchange of staff and knowledge.

#### 2. Participating in Plant Production Division, ALRC seminars and monthly meetings

Besides attending seminars given by visiting researchers of ALRC and staffs of Plant Production Division as well as seminars of other visitors, I have given four presentations; two for the Plant Production Division and the other two for the staff of ALRC and Tottori University on the following topics related to my research experiences:

- Fighting Soil Erosion in Ethiopia: An Issue for Decades to Come, Plant Production Seminar January 16, 2013
- Effects of SWC on land productivity and farmer's income: A case study in Ethiopia, Presented on Open Seminar of ALRC, March 6, 2013, Tottori
- Ethiopian soil resources: The case of Lake Tana basin, Plant Production Seminar July 3, 2013
- Impacts of land certification on farmers' perception on holding rights and land management in Amhara region, Ethiopia, September 12, 2013, Tottori University

Besides presentation these papers, I participated in monthly meetings of the Division with professor Tsunekawa and reported my progresses of work 12 times. Such interactions were so important to know the type of research done in the Division and exchange ideas and opinions.

#### 3. Undertaking research activities

As per the plan, involving in research was sought as a means to contribute to the advancement of knowledge and upgrading the practical skills of the researcher.

Therefore, investigating the chemical and physical properties of selected soil in Lake Tana basin of Ethiopia has been identified as important research topic during the period. The research topic was selected because such comprehensive studies are usually absent. Moreover, many properties of Ethiopian soils such as clay mineralogy, micro nutrient status, water retention properties and others are not well known. Understanding such properties will help to manage the soil resources effectively and wisely. Accordingly, a research protocol has been developed, commented by soil scientists at Tottori University, import permit to Japan processed, sampling materials purchased and a business trip to Ethiopia was organized between between 31 March and 8 May, 2013. Samples have been collected from 30 sites with three replications and related information has been collected. After drying, 125 g of soil has been weighed from each sample. Moreover, some core samples have been collected to measure the hydraulic conductivity of some selected soils. A total of 14.5 kg soil samples was measured and sealed to be transported to Japan. Moreover, additional information about the sampling sites such as coordinates, slope gradient, altitude, crops grown for the last three years, amount of fertilizer received, yield levels, infiltration rates, and soil hardness tests were collected. Some amounts of soil from each sample were left at Bahir Dar Soil Laboratory to analyse soil pH, electrical conductivity and bulk density so that the amount of soil to be transported to Japan was reduced. Acquiring soil export permission letter written from Ethiopian Ministry of Agriculture to Revenues and Customs Authority was important to finalize the clearance of soil sample export to Japan. Soil samples were then brought to ALRC after being inspected at Plant Quarantine section of Kansai Airport.

At ALRC the following soil parameters have been investigated; soil moisture contents, carbon and nitrogen, soil texture, available phosphorus, total phosphorus, available and total micro nutrient contents, clay mineralogy, hydraulic conductivity as well as phosphorus absorption isotherm.

It is now being planned to produce two research papers; one on general soil properties of the Lake Tana basin area and the other one on the phosphorus absorption isotherm of some selected soils which planned to be finalized during the first four months of the year 2014.

**Panda, Sudhindra Nath (Prof., Integrated Land & Water Resources Management)**

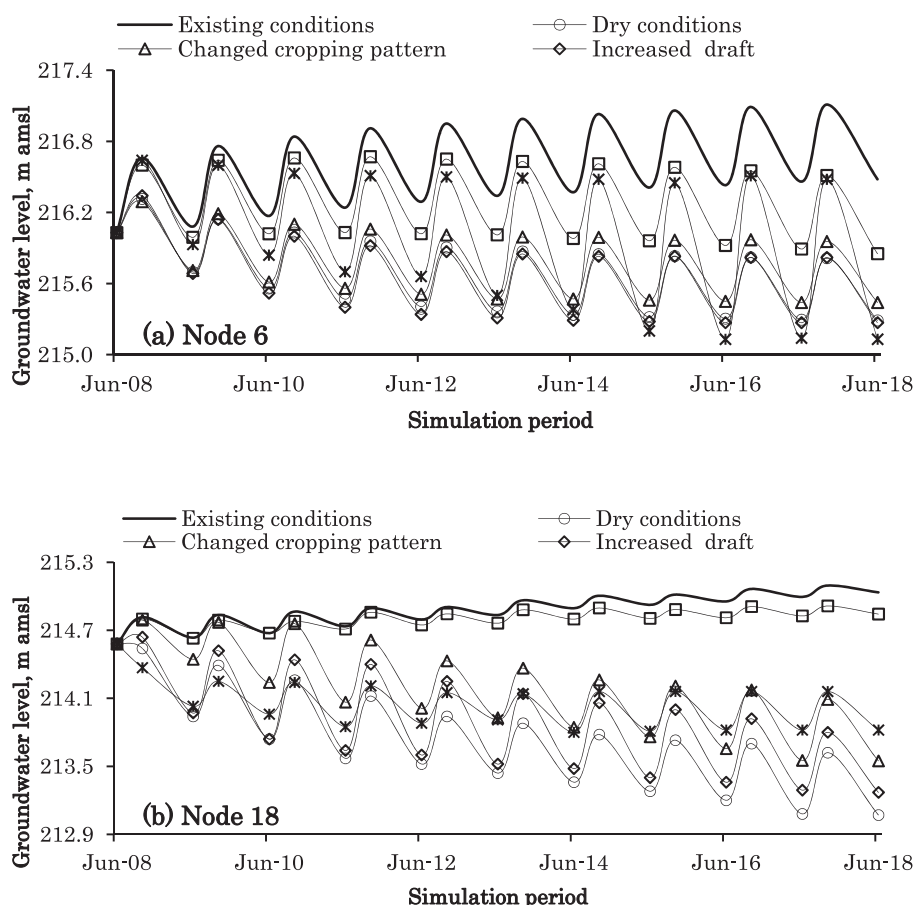
April 2013–March 2014

Title: Hydrology and Sustainable Water Resources Management of Arid Environments

More than one-third of the irrigated land of the world is facing the problem of waterlogging and soil salinization, which is more serious in arid and semi-arid regions. An integrated spatial agro-hydro-salinity model (SAHYSMOD) has been used to analyze water and salt balances of an irrigated semi-arid area located in Haryana State of India where groundwater level is rising continuously. The calibration and validation of the model were performed and the results show a good agreement between the simulated and observed groundwater levels (Fig) and salinities for all the nodes. Based upon the simulation results, it is apparent that SAHYSMOD seems to be an effective tool for groundwater simulation. It has the potential of assessing the watertable behaviour due to various interventions. The results of simu-

lation studies of existing and proposed water management policy, therefore, may form the basis for the identification of appropriate water management plans for the future. Each of the groundwater management strategies, discussed, if implemented, would help considerably to reduce the rate of watertable rise. The following specific conclusions and recommendations could be made from the study:

- Cropping pattern should be changed and salt tolerant crop varieties should be introduced in place of rice.
- Groundwater withdrawal should be increased by 1–8% by installing more tubewells at various locations and encouraging farmers to use poor quality groundwater in conjunction with fresh quality canal water.
- The lining of surface irrigation conveyance systems is suggested to reduce seepage rates from an unlined canals, which are about four times higher than the seepage rates of lined canals.
- It is concluded from the analysis of various scenarios that implementing multiple approaches simultaneously are more effective in controlling environmental problem of waterlogging as compared to individual interventions.



Predicted groundwater levels under different scenarios at Nodes 6 and 18

**Mohamed Ahmed Ali, Isam Ali (Assoc. Prof., Microbial Biotechnology)**

October 2013–March 2014

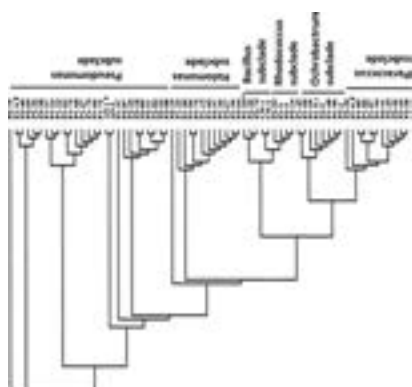
Title: Development of enzymatic methods for accurate determination of betaines in plants sample

During the past six months of my research, the following activities had been carried out

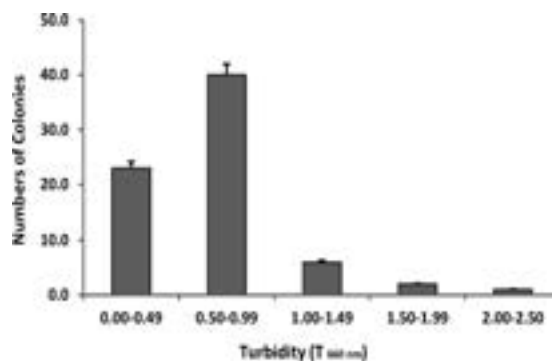
1. Mangrove forest survey and soil and/or plant samples collection from Okinawa Island (11 Nov. 2013–14 Nov. 2013)  
 In this trip, soil and plant leaves samples were collected from the mangrove growing sites in Okinawa Island. The aim of this sampling trip was to collect soil samples for the investigation of the metabolisms of glycine betaine by soil microorganisms that existing under the mangrove forest and thus to isolate an efficient enzyme from these microorganism that could be used for glycine betaine determination.
2. Attended biotechnology training course for developing countries that held in Beijing, China (29 Nov. 2013 to 4 Dec. 2013). In this course we gained much useful information about food and microbial biotechnology that will improve our biotechnological skill and thus helps in our ongoing and future research programmes.
3. Presented two papers in the 5 th annual conference of postgraduate studies and scientific research that held in Khartoum, Sudan during the period of 24–27 February, 2014.
4. Conducted field survey about the desertification and vegetation cover in Sudan (2 Mar. 2014–12 Mar. 2014). In this survey, interesting information about the Sahara desert in north Sudan and the vegetation cover therein as well as about the mangrove forest in Red Sea have been collected. Moreover, the vegetation cover throughout the desert, semi desert and poor savanna zones has also been surveyed.

Regarding glycine betaine measurements, the soil samples that collected from the mangrove growing sites at Okinawa were used to isolate bacterial strains that able to metabolize the osmoprotectant compound “glycine betaine” as sole source of carbon and nitrogen. Accordingly, more than 80 bacterial strains were isolated and genetically identified using 16 SrRNA identification method. The phylogenetic relationship between the isolated strains indicated their strong relation as they were clustered into six subclades (Fig.). These subclades include the genus; Pseudomonas, Bacillus, Rodococcus, Ochrobactrum, Paracoccus, and Halomonas. All these isolates were cultivated on glycine betaine media and the results showed that most of these bacterial strains grown well on glycine betaine ( $T_{660\text{ nm}} \geq 0.5$ ) as the sole source of carbon and nitrogen (Fig.). These results indicate the metabolic ability of glycine betaine by these isolates. Thus, these strains were selected as the most glycine betaine degrader and are expected to be an excellent source of suitable enzyme for glycine betaine estimation. The highly growth strains ( $T_{660\text{ nm}} \geq 1.0$ ) will then be screened for a good and stable enzyme to be used for accurate measurement of glycine betaine in plant samples.

Regarding other betaines such as L-carnitine measurements,  $\gamma$ -butyrobetaine, and  $\beta$ -alanine betaine, the enzymes L-carnitine dehydrogenase,  $\gamma$ -butyrobetainyl-CoA synthetase, and DddD enzymes have already been isolated and characterized. These enzymes together with that of glycine betaine degradation pathway from the isolated strains will be used for the determination of L-Carnitine,  $\gamma$ -butyrobetaine,  $\beta$ -alanine betaine, and glycine betaine, respectively.



Phylogenetic tree based on 16 SrRNA sequences of the isolates.



Histogram showing the cell growth of the isolated strains

October 2013–March 2014

Title: Incorporation of the Developed Ecosystem Model into an Integrated Wind-erosion Scheme

Aeolian processes in temperate grasslands (TGs) are unique in that the plant growth-decay cycle, induced-grazing, and weathering process. TGs are sensitive to climate change and increased anthropogenic pressure such as overgrazing. For instance, overgrazing results in decreased vegetation and enhances wind erosion and soil nutrient loss which restrict the recovery of grasslands in the subsequent growing season. This positive feedback constitutes an important mechanism for the desertification of the grassland. Therefore, this important feedback between grassland vegetation-wind erosion, which is so far not well understood and not to mention quantified. Moreover, current existing dust models do not have sufficient capability in simulating vegetation growth and decay effects that play a major role in TG Aeolian processes. In this fiscal year, our objectives were (1) to understand the feedback between grassland surface parameters-wind erosion, (2) to couple the developed ecosystem model into an integrated wind-erosion scheme, and (3) to assess vulnerability of the Asian and African TGs ecosystem to dust events. Brief results of each topic and its related ones are given below:

1. *Understanding the feedback between grassland surface parameters-wind erosion:* We examined the effects of memory of grassland elements (such as soil moisture and vegetation) on dust emission in the Mongolian TGs as land surface parameters simulated by the DAYCENT ecosystem model (vegetation-growth and nutrient-cycle model, which developed in TG ecosystem) in validation with field measured values during 2003–2010. Dust saltation flux in spring of 2008 and 2009 data enabled us to examine the relationships between dust emission and land surface parameters. Results showed that the DAYCENT could simulate realistically vegetation growth-decay, nutrient-cycle and the effect of grazing on TGs, which suppressed dust outbreaks. It was found that vegetation and soil moisture anomalies during the dust emission in spring are strongly dependent on the preceding year (autumn) vegetation and soil moisture, which were controlled by rainfall during a given summer. This indicated that larger (or smaller) rootstock of the steppe plants produced during the wetter (or drier) growing season may be maintained in the frozen soil during the winter and provide a basis for producing a larger (or smaller) vegetation in the spring. These results suggest that the vegetation produced in the previous summer remains through the succeeding cold grazing season it may exert a carry-over effect on spring dust emission. Moreover, the simultaneous correlation analysis showed that the standing vegetation was the primarily controlling factor in dust emission in spring, while the current soil moisture was the secondary (Nandintsetseg, Shinoda and Shao, 2014, under preparation for submission to Journal of Aeolian Re-

search).

2. *Incorporation of the developed ecosystem model into an integrated wind-erosion scheme:* Presently, we are in the process of incorporating the developed DAYCENT ecosystem model into an integrated wind-erosion scheme "QF 2003". This approach is a completely new approach. The DAYCENT is a mixed language program written in FORTRAN and C, and the QF 2003 is written in FORTRAN. We coupled the two different programs of DAYCENT and QF 2003, and conducted the numerical test of the coupled TGs wind-erosion model using a 9-year run from 1 Jan 2002 to 31 Dec 2009 at Bayan-Unjuul (BU) in Mongolian TGs. Based on the preliminary results, we have demonstrated the potential of the test version of DAYCENT-QF 2003 coupled model. The simulation shows that dust emission significantly depletes the surface soil nitrogen, and wind erosion can substantially reduce the surface vegetation cover. It can be further concluded that the effect of dust on vegetation simulation using DAYCENT very much depends on the choice of the management mode such as grazing. Presently, the coupled DAYCENT-QF 2003 wind-erosion scheme is under process of validating and calibrating with real dust emission and vegetation field measurements at the BU.

3. *Assessment of vulnerability of TGs ecosystem to dust events:* Climate change studies showed that TGs are facing negative climate change impacts, which induced significant vulnerabilities in the region as a result of extreme weather events such dust and droughts. It was found that dust emission is frequently occurred following a drought year. During the past multi-decades, strong drying trend observed in TGs. These conditions exacerbate the vulnerability of the TGs to the dust event and also the increase in dust event frequency in future (Nandintsetseg and Shinoda, 2014). Therefore, it is important to assess response of vegetation to drought. We measured continental-scale responses of vegetation to drought and ecosystem vulnerability and instability on the African arid regions using new sensitivity and resilience indices. Results showed that reliance was smaller than sensitivity over the study regions. This ecosystem response to drought explained by human induced (e.g., overgrazing) land degradation (desertification) in this arid region.

#### (4) プロジェクト研究員

##### 留森 寿士 (乾燥地植物資源バンク室)

乾燥地は、生産性が低いため貧困度が高く、さらに生態系も脆弱なため、過放牧や過伐採、過耕作などの人為的要因により砂漠化が進んでいる。これら乾燥地が抱える問題に対処するため、地域住民の従前の農業形態や生活様式を極力変えない、環境保全と貧困削減を同時に達成する新しい栽培・緑化手法を開発することを目指している。このため、①植物資源の有効活用、②環境耐性を持つ品種・系統の開発、③乾燥地に適した栽培・緑化手法の開発を行っている。

バイオ燃料生産は日常生活に必要なエネルギーの確保のみならず、慢性的な貧困を抱える乾燥地の農村社会における収入の向上による貧困削減の手段として期待され、導入が促進されている。さらに、植物由来の原料を燃焼して排出される二酸化炭素は、植物が大気中から吸収したものであるため、二酸化炭素の排出量はゼロと考えられ、地球温暖化防止の対策として、石油に替わる非枯渇性資源として注目されている。しかし、乾燥地における植物によるバイオ燃料生産は、順調に進んでいるとは言えない。そこで、乾燥地での栽培が期待される油料植物であるジャトロファの植物資源を活用した、生産向上に資する研究を進めている。

本年度は、以下の研究を進めた。

- メキシコ合衆国において、多収系統ジャトロファを調査した。
- 福井ら (大阪大学) と共同で、環境ストレス耐性向上のための形質転換植物の作製および DNA マーカーを用いた在来・野生系統の選抜と環境再現装置を用いた環境ストレス能の評価を行った。
- 明石ら (鳥取大学農学部) と共同で、悪環境下におけるジャトロファ花成・登熟および代謝調整技術によるバイオ燃料生産強化のシステム開発を行った。
- 果樹等の育成にも適応可能な人工光源システムを開発した。



Jatropha line bearing many fruits.

#### (4) Project Researchers

##### Hisashi Tomemori (Laboratory of Arid Land Plant Resources)

Owing to the low land productivity, drylands have high poverty rates. Furthermore, because their ecosystems are fragile, desertification is proceeding due to anthropogenic factors including overgrazing, excessive logging, and overcultivation. To deal with the problems faced by drylands, we aim to develop new cultivation and greening techniques that achieve both environmental conservation and poverty reduction with minimal changes to the inhabitants' customary forms of agriculture and ways of life. For this purpose, we are developing: (1) ways to effectively use plant resources; (2) crop varieties and strains with environmental tolerance; and (3) cultivation and greening methods suited to drylands.

Biofuel production is being encouraged because it offers hope not only for securing the energy needed for daily living, but also for providing a means of reducing poverty by raising incomes in dryland rural societies, which suffer from chronic poverty. And yet, it would be hard to say that biofuel production from plants in drylands is proceeding smoothly. For this reason, we are conducting research that will help improve the production of jatropha, a drought-tolerant oil plant with prospects for dryland cultivation by utilizing of plant resources. For the fiscal year 2013, we promoted the following research.

- We searched for jatropha with much oil quantity of production in United Mexican States.
- In collaboration with Prof. Fukui and others at Osaka University, we did research on production of genetically-engineered plants and selection of native or wild lines for improvement of the stress tolerance, and evaluation of the tolerance by using environment simulators.
- In collaboration with Assoc. Prof. Akashi and others at Tottori University, we did research on a systematic approach for the fortification of biodiesel production via engineering of flowering, fruit maturation and metabolic control in Jatropha under adverse environmental conditions.
- We developed the artificial lighting system which can be adapted also for cultivation of fruit trees etc.



LED lighting system for tree plants.



**井上 知恵 (乾燥地植物資源バンク室)**

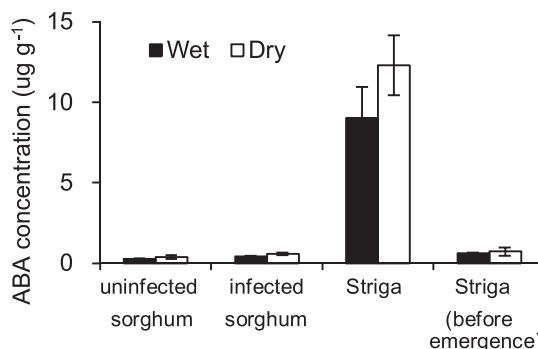
根寄生植物ストライガ (*Striga hermonthica*) は、ソルガムやパールミレットなどのイネ科の主要作物に寄生することから、アフリカの乾燥地で主要作物の収量低下の最も大きな生物学的要因となっている。ストライガは宿主植物の根に吸器と呼ばれる器官で結合し、蒸散流により宿主同化産物を収奪する。これまで、ストライガと宿主の光合成特性や気孔応答について、スーダン科学技術大学の研究者らと共同研究を行ってきた。土壤乾燥条件下でストライガの被害が深刻であることから、本年度は、異なる土壤水分条件下でのストライガと宿主のソルガムの気孔応答および気孔閉鎖に関わる植物ホルモンのアブシジン酸 (ABA) の影響を調査した。ストライガはソルガムに比べて、土壤乾燥および ABA 葉面散布処理に対して気孔コンダクタンスおよび蒸散速度の低下が小さいことが分かった。また、土壤水分条件に関わらず、ストライガはソルガムに比べて内生 ABA 濃度が約 10 倍高く、ストライガ寄生によりソルガムの ABA 濃度は増加した。そこで、ストライガの寄生によるソルガムの ABA 濃度の増加がストライガからの転流によるものかどうかを調べるため、ストライガの葉に d6-ABA を塗布し、4 時間後にソルガム最上位完全展開葉を採取した。その結果、12 反復中 4 つのソルガム個体で d6-ABA が検出されたが、残りの個体では検出限界以下であった。今後は、d6-ABA の処置時期やサンプリング時期等を検討し、調査を行う予定である。さらに、ストライガに寄生されたソルガムの最上位完全展開葉に  $^{13}\text{CO}_2$  処理を行い、土壤乾燥処理が同化産物の分配に及ぼす影響を調査した結果、ソルガムからストライガへ転流された  $^{13}\text{C}$  は土壤水分条件に関わらずほぼ一定であった。したがって、土壤乾燥条件下では、ソルガムは光合成速度が低下するのに加えて、ストライガへの同化産物の転流が維持されるために、ストライガの寄生による被害が深刻化すると考えられた。



Uninfected (left) and infected (right) sorghum

**Tomoe Inoue (Laboratory of Arid Land Plant Resources)**

Root hemi-parasite *Striga hermonthica* parasitizes gramineous plants, including sorghum and pearl millet, so that the most serious biotic constraint on crop production in the dry areas of Africa. *S. hermonthica* damage on crops is more serious under drought. *S. hermonthica* attaches to the host by the haustoria, and extracts solutes via the transpiration stream. I have conducted joint research on photosynthetic capacity and stomatal responses in *S. hermonthica* and host sorghum with the researchers at the Sudan University of Science and Technology. In this fiscal year, effect of soil water stress on stomatal closure and phytohormone abscisic acid (ABA) that regulates stomatal closure in *S. hermonthica* and sorghum were investigated. Under soil water stress and foliar application of ABA, reduction in stomatal conductance and transpiration rate in *S. hermonthica* was lower than in sorghum. Irrespective of the soil water conditions, endogenous ABA concentration in *S. hermonthica* was about 10 times higher than in sorghum, and *S. hermonthica*-infection increased ABA concentration in sorghum. To clarify if high ABA concentration in infected sorghum was derived from *S. hermonthica*, upper-most fully expanded leaf in infected sorghum was sampled 4 hours after d6-ABA was applied to *S. hermonthica* leaves. Among the 12 plants, d6-ABA was detected in 4 infected sorghum plants. The d6-ABA application and sampling times should be modified for further research. Also, to evaluate the effect of water stress on assimilate distribution in a host-parasite association,  $^{13}\text{CO}_2$  was fed on upper-most fully expanded sorghum leaves.  $^{13}\text{C}$  atom% in *S. hermonthica* was similar under both wet and dry conditions. Thus, it was indicated that in addition to a lower its photosynthetic rate, maintenance of host carbon uptake by *S. hermonthica* induced severe damage to the sorghum under dry condition.



ABA concentration in sorghum and *Striga hermonthica*

### E. Habora, Mohamed E. (分子育種学)

農業生産は乾燥や塩のストレスによって悪影響を受けている。進行中の気候変動に伴い、砂漠化と塩害の拡大が予想され、これが増加する世界人口の食糧安全保障の驚異となっている。

近縁野生種のゲノムにある利用可能な遺伝資源を活用すれば、栽培植物の耐乾性、耐塩性を高めることができるかも知れない。コムギ連の野生植物は、コムギ (*Triticum aestivum*) の耐乾性、耐塩性の改善にすばらしい遺伝資源であると見られている。特に、ハマニンニク (*Leymus mollis*) は、遠縁交雑によりコムギにその染色体および有用形質を導入すれば、有用な遺伝資源である。

分子育種学分野において、私の研究の目的は以下の通りである。

1. ハマニンニク染色体添加系統および合成コムギにおける、節肥性等の有用形質の選抜
2. ハマニンニクの耐乾性、耐塩性に関与する遺伝子のクローニング
3. トマトのような栽培植物の形質転換系の最適化

ハマニンニク染色体添加系統を肥料欠乏条件下で試験した。さらに、乾燥障害から細胞を保護する適合溶質、グリシン・ベタインの生合成と代謝に関与する酵素、phosphoethanolamine methyltransferase (PEAMT) の遺伝子の完全長遺伝子をクローニングした。

この研究結果を、オーストラリアと日本の国際学会において報告した。



Optimization of genetic transformation in plants

### Mohamed E. E. Habora (Molecular Breeding)

Agricultural production is adversely affected by drought and salinity stresses. With the ongoing climate change, increased desertification and salinization are expected, which could threaten global food security of the growing world population.

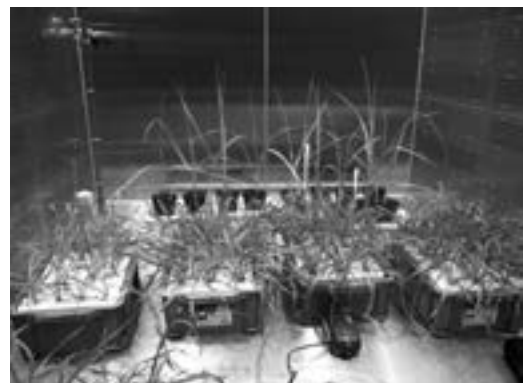
Improving the tolerance of cultivated crops to drought and salinity stress could be achieved by utilization of genetic resources available in the genome of wild relatives of plants. Wild plant species of the tribe Triticeae is considered as an excellent source of gene pool for improving the tolerance of wheat crop (*Triticum aestivum*) to drought and salinity stresses. Particularly, the dune grass *Leymus mollis* is a useful genetic resource for wheat breeding via wide hybridization to introduce its chromosomes and integrate its useful traits into wheat.

Within the Molecular breeding subdivision, my research focused on:

1. Screening wheat-*Leymus* chromosome addition lines and synthetic wheat for useful traits such as fertilizer-saving trait.
2. Cloning of useful genes from *Leymus mollis* for tolerance to drought and salt stress.
3. Optimization of genetic transformation protocols for food crops such as tomato.

Several wheat-*Leymus* chromosome addition lines were tested under fertilizer deficiency conditions. Additionally, the full length of an important gene called phosphoethanolamine methyltransferase (PEAMT) which is involved in the biosynthesis and metabolism of glycine betaine, a combatable solute which protects cells from dehydration injury.

Results of this research were presented in international conferences in Australia and Japan.



Screening of wheat-*Leymus* chromosomes addition lines using hydroponic culture

### Meshesha, Derege Tsegaye (土壌侵食・堆積学)

土壌侵食速度は、雨滴エネルギー(スプラッシュ効果)と土壌の受食性に依存するので、降雨侵食力 (R) と土壌受食性 (K) は土壌侵食プロセスのもっとも本質的なパラメータである。しかしいくつかの国では土壌侵食研究およびモデルの適用が行われているにもかかわらず、侵食の主要な駆動力となる降雨特性(侵食力)および実際に侵食される物質のベースとなる土壌の受食性 (K) といった土壌侵食の主要な個別パラメータについての研究はほとんど行われていない。このふたつの本質的なパラメータ(侵食力と受食性)に関する適当な方法および装置を用いた基礎的かつ信頼できる科学的測定は、十分には行われてきておらず、途上国においてはとくにそうである。

そこで2013~2014年に、乾燥地研究センターの研究設備(人工降雨装置およびレーザー降水モニターなどの光学測定装置)を用いて、さまざまな強度(1.5 mm/h~202 mm/h)の降雨をシミュレートして雨滴サイズ分布、運動エネルギーおよび対応する降雨強度に対する侵食ポテンシャルを評価した。さらにさまざまな日本の土壌(マサ土、黒ボク土、オキシソル、および砂質土)の受食性を評価した。この目的のため、土壌を5週間扱い、さまざまな密度、粒径および土壌湿度における土壌の受食性の変動を比較した。

その結果、本年度は以下のような成果を得た。

レーザー降水モニターを用いて人工降雨の新色力を評価した。降雨強度と運動エネルギーに関する関係を明らかにした。さまざまな土壌に対する侵食能と標準的な受食性に対する閾値を求めた。土壌間で顕著な受食性が認められた。



Measurement of runoff, sediment concentration and soil erodibility

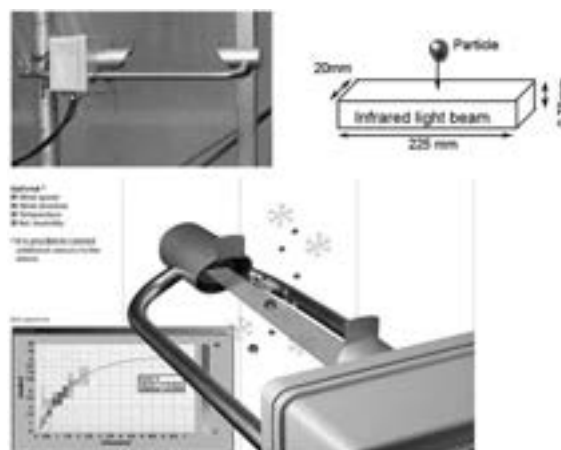
### Derege Tsegaye Meshesha (Soil Erosion and Sedimentation)

Rainfall erosivity (R) and soil erodibility (K) are the most essential parameters of soil erosion process. Because, soil erosion rate is dependent on raindrops (splash effect) energy and erodibility of the soil. However, even though efforts of soil erosion studies and adaptation of models are well going on in several countries, there have been very rare studies about the major individual parameters of soil erosion such as, character of rainfall (erosivity) which is the main driver of erosion and nature of soil erodibility (K) which is actually the material base to be eroded. Fundamental and dependable scientific measurements regarding the two essential parameters (erosivity and erodibility) have not been sufficiently done particularly in developing countries, using appropriate method and devices. Thus, in 2013/2014 research period, I used ALRC facilities (rainfall simulator and optical Distrometer i.e. Laser Precipitation Monitor), and simulated rainfall of different intensities (1.5 mm/h to 202 mm/h) and evaluated their drop size distribution, kinetic energy rate and erosivity potential of corresponding intensities; besides, I evaluated erodibility nature of different Japanese soils (Masa soil, Andosols, Oxisols and sand soil). To this end, I treated the soils for 5 weeks and compared erodibility variation of the soils at different bulk density, particle size and soil moisture content.

Thereby, I have gotten the following specific results in the year 2013/14:

Assessed application of Laser Precipitation Monitor (distrometer) to evaluate erosivity of simulated rainfall;

characterized rainfall generated by dripper-type rainfall simulator; established relationship between intensity and kinetic energy rates; determined threshold of erosivity and standard erodibility of the different soils, and obtained significant variation of erodibility among soils.



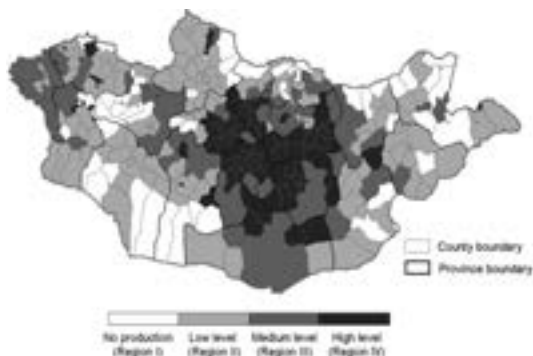
Applicability of Laser Precipitation Monitor to measure rainfall kinetic energy

**Bat-Oyun, Tserenpurev (農業気象学)**

以下のような研究に取り組んだ。

1. モンゴルにおける伝統的ミルク (アイラグ) に関する調査
2. モンゴルのステップ地域におけるアイラグの生産に対する天候や植生の影響に関する現地調査
3. モンゴルのステップ地域における植生変化に対する降雨変動や放牧圧の影響

1の課題に関して、モンゴル気象ネットワークを通して、2045の牧畜民を対象にアンケート調査を行った。アイラグ生産の活動指標として、総牧畜民に対するアイラグ生産を行う牧畜民の比を用いた。結果、はっきりとした地域差が認められた。すなわち、モンゴルの中央部では集中的に生産が行われているが、西部地域を除いたその周辺では生産が少ない(図)。中央のステップ地域や森林ステップ地域では馬の飼育数が多く、環境気候学的にその説明がつくが、西部地域の生産の少なさを説明できなかった。したがって、文化や民族性の違いがアイラグ生産の地域差を生んでいるのかもしれない。2の課題に関して、馬に取り付けたGPSによる追跡、気象観測ステーションを使った気象観測、植生調査、馬の体重変化、アイラグの微生物調査をMogod村で2013年の6月~9月まで行った。3の課題に関しては、植生の地上部バイオマスの調査である。*Stipa krylovii*、*Agropyron cristatum*は減少する傾向にあったが、*Artemisia adamsii*、*Chenopodium spp*、*Salsola spp*は放牧圧によって増加する傾向にあった。8年間における植生データによると、一年草の増加は現在または前年の降水量に依存していること、すなわち、湿潤年の一年草は連続的な乾燥年に支配されていた。これらの結果を *Journal of Arid Environments* に投稿した。



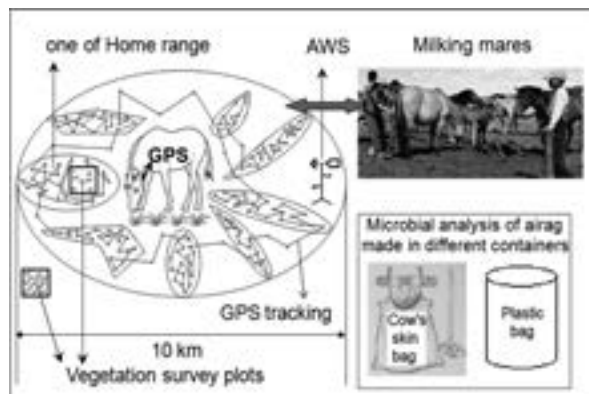
Airag production map (county scale)

**Tserenpurev Bat-Oyun (Agricultural Meteorology)**

In the last fiscal year, I conducted research on following topics:

1. Retained tradition of *Airag* (Fermented Mare's Milk) production in Mongolia: A nationwide survey
2. Field observations on effects of weather and vegetation conditions on *airag* production in a Mongolian steppe
3. Effects of precipitation variability and grazing exclusion on vegetation dynamics in a Mongolia steppe.

To reach the objectives of first topic I carried out nationwide questionnaire based survey targeting 2045 herders through the Mongolian meteorological network. Activity level of *airag* production was defined on a county scale using the ratio of a herding household that produces *airag* to the total number of households. The survey demonstrated a distinct regionalilty; intensive production in central Mongolia, but less in surrounding areas, except along the western border (Fig.). High horse density in the central steppes and forest steppes provides an eco-climatological explanation, but this density pattern cannot explain lack of production in eastern areas. Thus, culture and ethnicity may account for *airag's* regionalilty. Research results from this study were submitted to *Nomadic Peoples* academic journal. On the second topic to investigate effects of weather and vegetation on *airag* quality and quantity, we have conducted field observations including GPS tracking with Mongolian horse, observation of weather condition with automatic weather station, comprehensive vegetation survey, horse weight measurement, and microbial analysis of *airag* made in different containers (traditional cow's skin bag and plastic container) in a *Mogod* village of Mongolia between June-Sep, 2013 (Fig.). Main results from the third topic was aboveground biomass (AGB) of palatable species such as *Stipa krylovii*, and *Agropyron cristatum* tend to decrease while increases of AGB of unpalatable species such as *Artemisia adamsii*, *Chenopodium spp* and *Salsola spp* were seen under grazing disturbance. Moreover, eight years vegetation data revealed that the increases of annual species were characterized by the amount of plant-available precipitation in the current and preceding years; annuals dominated in wet years, which were followed by consecutive dry years. Research results from this study were submitted to *Journal of Arid Environments* academic journal.



Outlook of the field observations on *airag* study

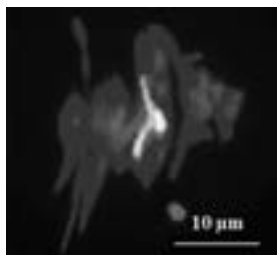
### 趙 晟佑 (植物分子細胞遺伝学)

コムギは世界三大作物の一つであり、人への好適な植物タンパク質供給源でもある。しかし、近代農業における選抜育種のために、コムギの遺伝的多様性は縮小している。この状態はコムギの遺伝的変異に限界を生じ、乾燥、塩害、病気のような生物学的および非生物学的ストレスの抵抗性を弱めている。私の研究は、乾燥地での育種のための遺伝子供給源としてコムギと野生植物の染色体工学に的を絞って行っている。

近縁野生種はコムギの改良に利用されている。様々な非生物学的ストレスをもち、長く密な根圏をもつハマニンニクおよびオオハマニンニク ( $2n = 4x = 28$ , NsNsXmXm) は、非常に有用なコムギ近縁野生種である。染色体工学技術を用い、私はハマニンニクとオオハマニンニクの染色体をもつダブルモノソミック添加系統 (DMA) を作った、そして、その系統にライムギのB染色体を導入、または、DMAへゼブラリンを処理した。染色体接合を研究するため、その植物材料の減数分裂を観察した。この研究の主な目的は以下の通りである：

- 生物学的および化学的方法による減数分裂組換えの頻度の向上
  - コムギに存在する異種植物同定のための分子マーカー分析システムの開発
- 本年度は、上の課題について以下の結果を得た。

1. ライムギB染色体の染色体対合に及ぼす影響。2つの型のB染色体が存在した。両B染色体のタイプは第一減数分裂の過程で二価染色体の頻度の増加に影響を及ぼした。しかし、相同指数はライムギB染色体に影響を与えない、なぜなら二価染色体は第一減数分裂に還元分裂をせず、一価染色体のように均等分裂をしたからである。これらのことは、たとえライムギB染色体が、それらのパートナーの混乱を起こしても、両相同染色体は互いに強く認識されていることを示している。
2. ゼブラリンが染色体接合に及ぼす効果。DNAメチル化の阻害剤であるゼブラリンは染色体切断を誘発する。この人為的な染色体切断は、低濃度でも染色体接合を高めることが分かった。低濃度でも非常に強い連結状態を見いだした。
3. コムギの遺伝的背景での異種染色体同定のためのESTマーカーの開発。ESTデータベースを用い、私はコムギの遺伝的背景に存在する異種植物同定のためのマーカーを選抜した。そして、コムギ染色体の間に存在するハマニンニク染色体を識別するマーカーを同定した。



Chromosome association of two different *Leymus* chromosomes (bright) by rye B chromosome

### Seong-Woo Cho (Plant Molecular Cytogenetics)

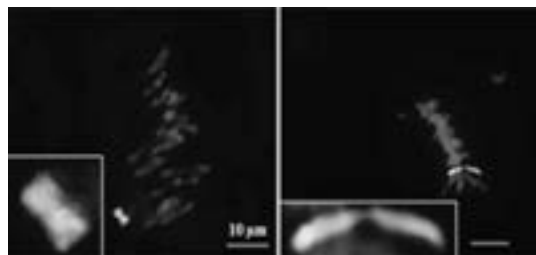
Wheat is one of three major cereal crops in the world. Also, it is a good source of vegetable protein for human. However, the genetic diversity of wheat is narrowed by selection breeding in modern agriculture. The situation causes limitation of wheat genetic variation and leads to less tolerance to biotic and abiotic stresses such as drought, salinity and diseases. My research focuses on chromosome engineering on wheat and wild plants as genetic resources for breeding in arid land.

Relative wild species are used for breeding improved wheat. *Leymus mollis* and *L. racemosus* ( $2n=4x=28$ , NsNsXmXm), with its remarkable tolerance to various abiotic stresses and its long and dense rhizosphere is very useful wild relative of wheat. Using chromosome engineering technologies, I produced wheat double monosomic addition line (DMA) with rye B chromosome and treated DMA with zebularine. To investigate chromosome association, I observed meiosis of the plant materials. Main purposes of this research are as following:

- Improvement of frequency of meiotic recombination by biological and chemical methods for genetic diversity.
- Development of molecular markers analysis system to identify alien chromosomes in wheat.

In this fiscal year, I got the results from the subject following above:

1. Observation of effect of rye B chromosomes on chromosome pairing. There were two types of rye B chromosomes. Two types of rye B chromosomes affected that frequency of bivalent was increased during the first metaphase. However, efficiency of homology was not affected by rye B chromosomes. It was expected that the formation of bivalent was under like behavior of univalent as equational division. It may indicate that each homologous chromosome strongly recognize each other even rye B chromosome lead to confuse their partners.
2. Observation of effect of zebularine on chromosome association. Zebularine, DNA methylation inhibitor cause chromosome breakage. This artificial chromosome breakage led to promote chromosome association even in low frequency. I observed very strong connector between two *Leymus* chromosome even in low frequency.
3. Development of EST markers to identify alien chromosomes in wheat genetic background. To select markers for identification of alien chromosomes in wheat is used EST database of *Leymus* species. I identified markers to distinguish *Leymus* alien chromosome among wheat chromosomes.



Chromosome association of two different *Leymus* chromosomes (bright) by zebularine

**徳本 家康 (土壌物理学)**

乾燥地における水・窒素循環の把握は、水の効率的活用や低環境負荷に配慮した持続的農業に重要である。ポスドクにおける研究では、乾燥地における水・窒素循環の観測および予測のための基礎研究として、砂丘畑における水分・窒素移動および温室効果ガスの発生量の予測の検討 (図)、土壌水分センサーとして知られている時間領域透過法センサーの評価、さらに半乾燥地の石礫土壌水分移動のモデル化に関連する以下の研究を行った。

- 砂丘畑における水分・窒素移動の観測
- トウモロコシ砂丘畑からの CO<sub>2</sub>、CH<sub>4</sub>、および N<sub>2</sub>O ガス発生量のモデル化
- TDT センサーの性能評価
- 石礫土壌の水分保持特性モデルに関する研究

これらの研究は、アメリカのテキサス A&M 大学や佐賀大学との共同研究で行った。

本年度は、特に以下の研究で成果を得た。

1. 砂丘畑における水分・硝酸態窒素移動の観測：水と窒素の収支の解析において、深さ 3 m における硝酸態窒素の下方浸透は環境基準値よりも高く、水と肥料の投入量および施肥タイミングの重要性を明らかにした。
2. 温室効果ガスの発生量：液肥施用の砂丘畑からの温室効果ガス発生量は、より有機物の多い一般的な土壌に比べて、温室効果ガスの発生量は 1/100 程度ほどであることが判明した。
3. TDT センサーの評価：TDT センサーは、世界中で広く利用されている土壌水分センサー (TDR センサーなど) に比べて、電気伝導度が 10 dS/m と高い土壌においても精度よく土壌水分量の計測が可能であることが明らかになった。
4. 石礫土壌の水分特性曲線：石礫土壌における水分保持特性曲線のモデルには、従来の S 形状の曲線を数学的表記する van Genuchten モデルよりも、多数の曲線近時を可能とする Durner モデルが有効であるが (図)、土壌の不飽和透水係数に依存する間隙連結係数の決定が重要であることがわかった。

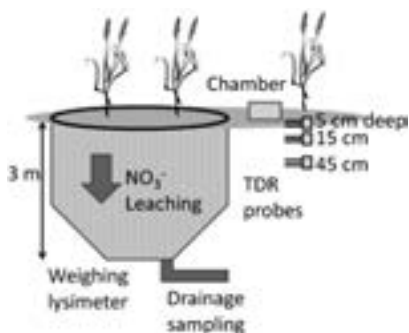


Diagram of a lysimeter for monitoring soil water and nitrate transport.

**Ieyasu Tokumoto (Soil Physics)**

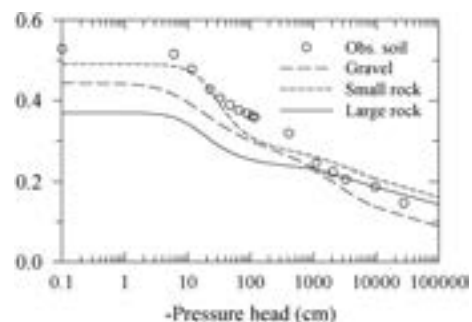
Soil water and nitrogen dynamics play important roles in sustainable agriculture to increase water use efficiency and low loss environmental impact. During postdoc, my research projects are simulation of water, nitrogen, and greenhouse gas emissions (GHGs) (Fig.), evaluation of Time Domain Transmissiometry sensor known as soil moisture sensor, and modeling of water retention curves for rocky soils in order to improve basic conception for soil water and nitrogen movements and simulation in arid lands. Followings are the topics of my research:

- Investigation of soil water and nitrogen in sandy fields
- Modeling of greenhouse gas emissions from corn-sandy fields
- Performance evaluation of TDT sensors
- Studies on water retention curves for rocky soils

A couple of these research projects are being conducted at Texas A&M University, USA, and Saga University, Japan.

In this fiscal year, I obtained results from following research:

1. Soil water and nitrate dynamics in sandy fields: With the water-and-nitrogen balance method, we found high nitrate concentration (>10 mg/L) at a depth of 3 m, indicating that the amount and timing of water and fertilizer supply are important.
2. GHGs: Greenhouse gas emissions from sandy fields with liquid fertilizer treatment were 1/100 times less than that from soil containing higher soil organic material.
3. TDT sensor evaluation: Comparison TDT sensor with Time Domain Reflectometry (TDR) sensor shows that TDT sensor performed adequately to monitor soil water content in salinity soil (EC>10 dS/m).
4. Water retention curves for rocky soils: For modeling of water retention curves of rocky soils, Durner model, which expressed as multiple S-shape curves mathematically, was more appropriate than the VG model, which expressed as a S-shape curve (Fig.), but needs better parameter estimation for pore-connectivity to describe unsaturated hydraulic conductivity of rocky soils.



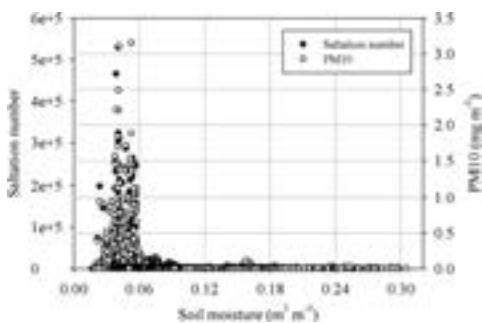
Water retention curves for the gravel, the small rock, and the large rocks using the Durner model.

**阿不力提甫 阿不来提 (農業気象学)**

東アジアの乾燥・半乾燥地域における黄砂の発生は、発生源だけではなくその周辺国の人々や家畜への健康、大気汚染、農業または局地的な生態系に重大な影響を及ぼしている。黄砂発生モデルに考慮されている地表面パラメータには土壌粒径分布、植被率、粗度などがあるが、黄砂の発生頻度は植被率、土壌水分、積雪等によって決定される臨界風速に依存している。したがって、地表面の状況と黄砂の発生との関連性を物理的に把握することは、早期警戒情報等の改良に役立てることができる。

本研究の目的は、黄砂や飛砂の発生と地表面状態との関係をモンゴルの砂漠ステップ、中国の河西回廊、鳥取砂丘において、観測によって明らかにすることである。2013年度はモンゴルの黄砂発生源において以下のような結果を得た。

1. サルテーション数とダスト濃度は体積含水率が2-6%のときに高くなった (図)。
2. 2012年と2013年においては、規模の大きいダストイベントの後に臨界風速は急激に減少した。しかしながら、兩年の間には土壌水分や植被率の差は認められなかった (図)。
3. 臨界風速の変化は土壌の構造や氷結-融解サイクルの変化によるものと考えられた。



Relationship between saltation, dust concentration and soil moisture.

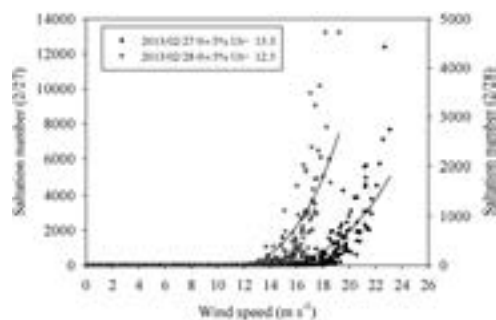
**Abulaiti Abulitipu (Agricultural Meteorology)**

Asian dust produced in arid and semi-arid regions of East Asia increasingly affects human and livestock health, air pollution, agriculture, and local ecosystems and not only in the source regions but also in downwind regions. Asian dust can affect the source area, surrounding areas, and the global climate. Most dust emission models include parameters to account for the effects of land-surface conditions such as soil particle size distribution, soil-surface characteristics, vegetation cover, and the roughness frontal area index. The frequency of dust occurrences is dependent on surface conditions that affect the wind speed threshold for erosion, such as vegetation cover, surface soil water content, and snow cover. Therefore, it is important to gain a better understanding of the physical relationships between surface conditions and dust outbreaks and thus improve the accuracy of early warning and monitoring systems

The purpose of my study is to clarify the relationship among soil/ vegetation conditions, and saltation/dust emission by using field observations on the grassland and desert steppe of Mongolia, Hexi Corridor in Northwest of China, and Tottori sand dune of Japan.

In fiscal year 2013, I obtained results as following:

1. Saltation number and dust concentrations were high when volumetric soil moisture content was 2-6%, and both decreased significantly when soil moisture exceeded 6% under strong wind ( $u > 7 \text{ m s}^{-1}$ ) conditions (Fig.).
2. Threshold wind speed decreased dramatically after large dust events in both 2012 and 2013, even though there was little change in soil moisture and vegetation cover conditions (Fig.).
3. The variations of threshold wind speed during dust-emitting periods likely reflect changes of soil structure, possibly related to the freeze-thaw cycle.



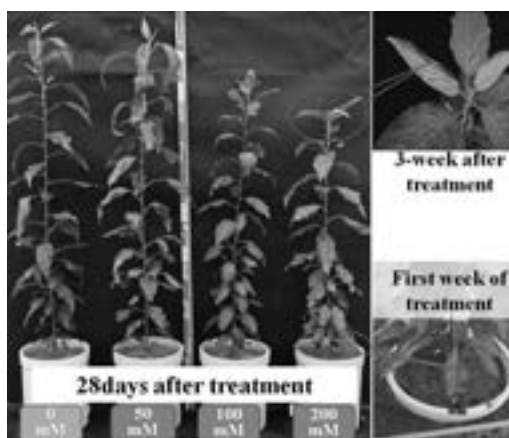
Relationship between saltation, dust.

### Ailijiang, Maimaiti (植物生理生態学)

乾燥地の厳しい環境ストレス条件下に生育する植物を対象にストレス生理生態学的研究を行った。特に乾燥地植物の乾燥や塩に対する反応と耐乾燥、耐塩性に関するメカニズムの解明と耐乾燥、耐塩性の向上に関する研究を重点的に行った。本年度の主要な研究内容は以下のようである。

土壌および水に含まれる塩分は最も重要な環境ストレスとして野生の植物や作物の成長抑制することが広く知られている。このような塩害の防止、対策としては灌漑や排水の適正な管理、耐塩性植物の導入や耐塩性の向上が求められる。このためには対象となる植物について、塩ストレスに対する生理的応答を理解することが必要不可欠となる。本年度の研究は、中国原産のナシの一種で、現在は日本やヨーロッパでナシの台木として使用されている *Pyrus betulaefolia* を対象として、塩ストレスに対する反応とその耐塩メカニズムの解明に関する研究を行った。実験は *P. betulifolia* の実生を 0-200 mM の塩類ストレス下で育成し、(i) 塩性環境下での成長や光合成特性、(ii) 異なる器官へのイオン蓄積、(iii) 植物体内における可溶性炭水化物類蓄積の時間変化等を調査した。

本年度の海外での研究活動としては、2013年6月12日~29日までアメリカのカリフォルニア大学リバーサイド校保全生物学研究センターを訪れ、乾燥地の現場で砂漠植物の生理について野外調査を行った。さらに、鳥取大学農学部板井博士と共に中国の新疆農業大学森林および園芸学部とコラのナシ研究所を訪問した。これらの訪問は2013年8月20日~29日の間に行われ、中国の新疆ウイグル自治区で広く栽培される園芸植物特にナシ類に関する調査を行った。



Growth changes of *P. betulifolia* seedlings at different NaCl concentrations

### Maimaiti Ailijiang (Plant Eco-physiology)

The Plant Stress Physiological Ecology conducts research on the elucidation of eco-physiological characteristics of plant species growing in harsh environment. Particular efforts are being made to clarify the responses of plants to salt and drought stresses and relevant mechanisms, and to develop stress tolerance of planting species. The main research in the fiscal year was as follows:

Salinity in soil or water is one of the major abiotic stresses that reduce plant growth and crop productivity worldwide. The scale of the problem of salinization is considerable and continues to grow. Overcoming soil salinity problems can be approached by managing irrigation and drainage and/or selecting (or engineering) plants to increase their tolerance. Therefore, understanding the basic physiological responses of plants to salinity stress is crucial for agricultural productivity. Aims of research in the fiscal year were to identify the tolerance mechanism of *Pyrus betulaefolia* (is native to northeast China and is now used as rootstocks for Japanese and European pear cultivation) to confront salt stress. The study evaluated the response of *P. betulifolia* seedlings to NaCl concentrations in the range 0-200 mM in terms of (i) growth and photosynthetic characteristics of *P. betulifolia* seedlings to salinity (ii) ion accumulation in different organs at various treatment period (iii) time course changes in soluble carbohydrates under salt stress.

Overseas research activities during the fiscal year 2013 include field researches at Center for Conservation Biology, University of California Riverside in the U.S from June 12 to 29, 2013. And, visit College of Forestry and Horticulture, Xinjiang Agricultural University and Korla Pear Research Center in Xinjiang, China, with Dr ITAI Akihiro (from Tottori Univ). We investigated some horticultural plants, especially pear, which is widely cultured in Xinjiang region from August 20 to 29, 2013.



Field research at Center for Conservation Biology in the U.S.A



## 石井 孝佳 (分子育種学)

パンコムギ (*Triticum aestivum*) はイネ科イチゴツナギ亜科に属しており、乾燥や塩害などの環境ストレスに弱い。コムギにストレス耐性を導入する事はコムギ育種において重要である。ソルガム (*Sorghum bicolor*)、パールミレット (*Pennisetum glaucum*) はイネ科キビ亜科に属しており、C4タイプの光合成を行っており、乾燥や塩害に対して耐性を持っている。しかし、コムギにソルガムやパールミレットを交雑した場合、雑種胚発生中にソルガムやパールミレットの染色体が選択的に脱落するため、コムギ育種においてソルガムやパールミレットの遺伝資源を利用できない。もし、染色体脱落機構を解明する事が出来れば、これまで利用不可能だったソルガムやパールミレットの遺伝資源をコムギ育種に利用できる可能性がある。そこで、我々の研究グループでは選択的な染色体脱落機構解明のために、様々なゲノム構成をしたコムギ連植物とエンバクをメス親とし、パールミレットをオス親として交雑した (図)。そして、雑種胚中の染色体の挙動解析から以下の点を明らかにした。

コムギ連の植物にパールミレットを交雑した場合、染色体脱落が起こる (図)。

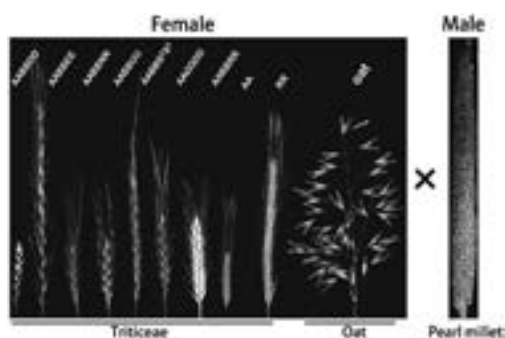
脱落するパールミレット染色体は、切断、転座、不分離、小核形成などの染色体異常を示した。これらの染色体異常は細胞周期後期で、発生した染色体の切断に由来している。

エンバクにパールミレットを交雑した場合、染色体脱落は起こらない (図)。

エンバクとパールミレットの雑種はシュートを形成したが、明条件にさらすと枯死した (図)。

エンバクとパールミレットの雑種カルスを得た (図)。

我々のグループは遠縁交雑雑種胚における染色体の挙動を明らかにした (図)。エンバクとパールミレットはそれぞれ異なるイネ科の亜科に属しているにもかかわらず、安定な真性雑種を形成した。エンバクとパールミレットの真正雑種はC3、C4光合成の両方を持つ雑種であり、世界初の報告である。現在エンバクとパールミレットの機能的な動原体形成に必須のCENH3遺伝子を解析している。さらなる染色体脱落機構解明に向けてへの研究が必要である。



Spikes of the various genome constitutions of Triticeae, oat and pearl millet.

## Takayoshi Ishii (Molecular Breeding)

Wheat (*Triticum aestivum*) belongs to the Pooideae of Poaceae, and is weak to the harsh environment such as drought or salinity. Inducing stress tolerance in wheat cultivars is important in wheat breeding. Sorghum (*Sorghum bicolor*) and pearl millet (*Pennisetum glaucum*) belong to the Panicoideae of Poaceae and have C4 photosynthesis system and have drought and salinity tolerance. However, in wheat breeding, we cannot use the sorghum and pearl millet genetic resources, because sorghum and pearl millet chromosomes are eliminated during the embryogenesis of the hybrids. If the mechanism of chromosome elimination is elucidated and can be controlled as desired, it will be possible to take advantage of the genetic resources of sorghum, pearl millet and other distantly related species for wheat breeding, and novel wheat cultivars with the characters of sorghum or pearl millet could be produced. In our group, in order to understand the mechanisms of chromosome elimination, we crossed between the plants with various genome constitutions in Triticeae or oat and pearl millet (Fig.). We analyzed chromosome dynamics during embryogenesis of the hybrid and revealed following points.

In cross between Triticeae and pearl millet, chromosome elimination occurs (Fig.).

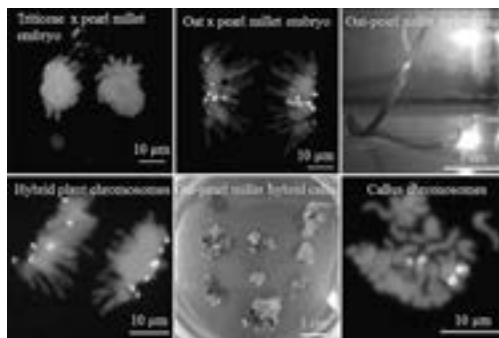
Pearl millet chromosome showed chromosome rearrangements and non-disjunction together with micronuclei. These rearranged chromosomes and micronuclei derived from the breakage of bridges and retention of acentric fragments in anaphase, respectively.

In cross between oat and pearl millet, chromosome elimination did not occur (Fig.).

In oat-pearl millet hybrid embryo generated shoot, but eventually died in light conditions (Fig.).

We got one callus of hybrid of oat-pearl millet (Fig.).

Our group revealed chromosome dynamics in embryogenesis of wide cross (Fig.). In oat-pearl millet, both species belong to different subfamily, but make stable hybrid. Oat-pearl millet hybrid plant is the first report of true hybrid between C3 and C4 plants. We are studying about kinetochore protein CENH3 of oat and pearl millet now. Further research is necessary for understand the chromosome elimination.



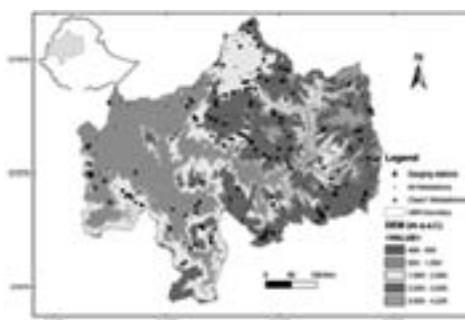
Pearl millet chromosome dynamics in embryogenesis, hybrid plant and callus cells. Bright parts indicate pearl millet chromosomes.

**Ayehu, Nigussie Haregeweyn (日本学術振興会特別研究員)**

青ナイル川上流域(図)は気候変動の大きさと土地劣化によって性格づけられる。適応能力を強化するため、さまざまな土壌・水保全(SWC)対策が広く実施されてきた。さらにグランドエチオピアルネッサンスダム(GERD)や同様のものなどのウォーターハーベスティングの構想が2025年までに実施されることになっている。本研究は、このような開発方策が表面の流出反応、堆積物や栄養物の輸送にどのような影響を及ぼすかを現在(2014年)と将来(2025年)の流域の条件でのシミュレーションにより明らかにしようとするものである。

現在の条件下では、平均年流出深において高い変動性が認められた(図、右上)。北東部に位置する青ナイル5流域では平均流出深が最大となり(391 mm)、北西部の青ナイル2流域では最小(177 mm)であった。流域全体では、総流出量は $48 \times 10^9 \text{ m}^3$ と推定され、そのうち約54%は耕地からのものであった。さらに流域は年間で $2.18 \times 10^9 \text{ ton(t)}$ の土砂堆積を生じ、そこに炭素 $30 \times 10^6 \text{ m}^3$ 、リン $1.77 \times 10^3 \text{ t}$ 、窒素 $3.27 \times 10^5 \text{ t}$ を含むことから、甚大なオンサイトおよびオフサイトの土地劣化につながっていることがわかった。

2025年までに流域全体でGERD貯水池に加えて十分な水士壌保全策が講じられれば、年流出深は最大36%まで減少する。しかし通常の管理が行われなければ、物理的な水士壌構造の十分な効果は1~2年間しか続かない。地区レベルあるいは地域レベルで意味を持つ開発方策の他の環境面での全体的な理解のためにさらなる研究が必要である。



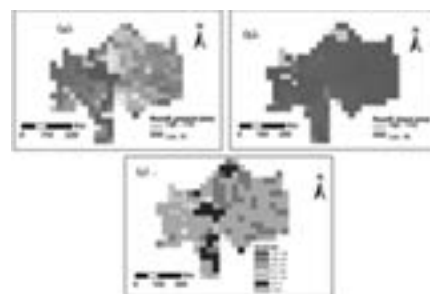
Location of the Upper Blue Nile basin.

**Nigussie Haregeweyn Ayehu (JSPS Postdoctoral Researcher)**

The Upper Blue Nile (UBN) basin (Fig.) is characterized by large climate variability and land degradation. To enhance the adaptive capacity, different soil and water conservation (SWC) interventions have been widely implemented. Moreover, water harvesting schemes such as the Grand Ethiopian Renaissance Dam (GERD) and similar others are to be implemented by 2025. This study aims to model the significance of such development interventions on surface runoff response, sediment and nutrient export comparing present day (2014) and future (2025) basin conditions.

Under the present-day basin conditions, high variability of mean annual runoff depth was observed (Fig, top right). The Blue Nile-5 subbasin in the northeastern part produces the highest mean runoff depth (391 mm) while the Blue Nile-2 subbasin in the northwest produces the lowest runoff (177 mm). The entire basin generates a total runoff volume of  $48 \times 10^9 \text{ m}^3$ , of which ca. 54% originates on cultivated lands. Moreover, the basin generates about  $2.18 \times 10^9 \text{ ton (t)}$  of sediment resulting an annual sedimentation rate of  $30 \times 10^6 \text{ m}^3$  of Carbon,  $1.77 \times 10^3 \text{ t}$  of phosphorus, and  $3.27 \times 10^5 \text{ t}$  of nitrogen, signifying the huge on-site and off-site consequences of land degradation in the basin.

By 2025, annual runoff depth could decrease by up to 36% if basin-wide and well-maintained SWC structures and interventions as well as GERD reservoir are realized. However, the full effects of physical SWC structures last only for one or two years unless regular maintenance is in place. Further research is required for a holistic understanding of other environmental aspects of such development interventions which have local and regional significance.



Average annual runoff (mm) for the Upper Blue Nile (UBN) basin (present: upper left, future: upper right and their difference: lower).

## 1.2 研究プロジェクト・教育プログラム

### (1) 黄砂プロジェクト

東アジアにおける黄砂の発生メカニズム解明、黄砂の影響評価および発生源対策技術の開発に取り組む、「東アジア砂漠化地域における黄砂発生源対策と人間・環境への影響評価（通称：黄砂プロジェクト）」（平成23年度～平成27年度）が文部科学省特別経費事業に採択された。

本事業では、砂漠化に伴う砂塵嵐・黄砂被害が広がっているモンゴルや中国の乾燥地現場において砂塵嵐、黄砂の発生メカニズムの解明を行い、乾燥地の現場と黄砂影響をうける日本国内において、黄砂が人間の健康、人間活動及び自然生態系に与える影響解明を行っている。さらに、発生国であるモンゴルや中国の現場において、効果的な砂塵嵐、黄砂の発生源対策に関する研究を行い、地域の実情に合った効果的な対処技術の開発を目指している。また、これまでの国際共同研究等で本センターが構築してきた学術ネットワークの活用により、モンゴル気象水文環境研究所、モンゴル農業大学、中国内モン古大学、中国内モン古農業大学、中国科学院寒区旱区環境与行程研究所、アメリカ砂漠研究所、ドイツ・ケルン大学等と連携して研究を推進している。

#### 研究内容

##### ●黄砂発生メカニズムグループ（リーダー：篠田雅人）

1. 黄砂発生における草原の空力学的・物理的影響の解明
2. 草原植生の成長・衰退を再現するモデルの構築
3. フィールド観測による既知の関係の広域展開
4. リモートセンシングによる黄砂発生パラメタの推定
5. 黄砂発生パラメタと植生モデルの風食モデルへの統合

##### ●黄砂影響評価グループ（リーダー：黒沢洋一）

1. 人体への影響
  - ・日本の黄砂の生体影響（黄砂および微生物とアレルギー）
  - ・発生源での生体影響（モンゴル住民の長期の影響評価）
2. 人間活動に与える影響
  - ・動物実験（慢性影響の評価）
  - ・モンゴルの家畜における植物中毒メカニズムの解明
3. 自然生態系に与える影響（発生源対策グループと連携）
4. 農牧畜に与える影響
  - ・発生源での農牧畜に及ぼす影響
  - ・発生源での気候変動（干ばつ）と農牧畜の関係

##### ●黄砂発生源対策グループ（リーダー：山中典和）

1. 風食対策技術のレビューと効果検証（発生メカニズムグループと連携）
2. 持続可能な飛砂防止緑化技術の開発
  - ・在来植生の回復技術開発
  - ・在来植物の植栽技術開発
3. 黄砂が自然生態系に与える影響評価（影響評価グループと連携）

## 1.2 Research Projects and Training Programs

### (1) Asian Dust Project

ALRC has started Asian Dust Project “Assessment and Control of Dust Emission in Degraded Drylands of East Asia” funded by the Ministry of Education, Culture, Sports, Science and Technology (MEXT) in FY 2011.

The aim of this project is to elucidate the sandstorm and dust emission mechanisms in the drylands of Mongolia and China, assess the effects of dust on human health, human activity and ecosystems in the source drylands and in Japan, and conduct research to develop effective measures to control sandstorms and dust emission in source areas.

We have been promoting collaborative research with the following international institutions: Institute of Meteorology, Hydrology and Environment (IMHE, Mongolia), Mongolian State University of Agriculture (MSUA, Mongolia), Inner Mongolia University (China), Inner Mongolia Agricultural University (China), Cold and Arid Regions Environmental and Engineering Research Institute, Chinese Academy of Sciences (CAREERI, CAS, China), Desert Research Institute (DRI, USA), University of Cologne (Germany), etc.

#### Research Summary

##### ●Dust Emission Group (Leader: Shinoda, M.)

1. Gain a deeper understanding of the aerodynamic and physical influences on grassland vegetation during wind erosion and dust emission processes
2. Conduct vegetation modeling of seasonal growth and decay and of the impact of grazing
3. Scale known relationships upwards to create a regional model
4. Quantify the critical parameters affecting dust emissions by using remote-sensing techniques
5. Conduct integrated wind-erosion modeling that incorporates a grassland aeolian database and a vegetation model

##### ●Effect Assessment Group (Leader: Kurozawa, Y.)

1. Study the effects of dust on human health
  - ・Effects in Japan and source areas
2. Analyze the effects of dust on human activity
  - ・Chronic effects of dust on animals
  - ・Livestock poisoning related to desertification in Mongolia
3. Evaluate the effects of dust on ecosystems
4. Study the effects of dust on agriculture and livestock farming in dust source areas
  - ・Effect of dust on agriculture and livestock farming
  - ・Effect of climate change (drought) on agriculture and livestock farming

##### ●Dust and Sandstorm Control Group (Leader: Yamanaka, N.)

1. Review measures to reduce wind erosion and evaluate the effects of measures
2. Develop sustainable measures to control dust and sandstorms
  - ・Develop the restoration technologies of original vegetation
  - ・Develop effective planting technologies for native plant species
3. Evaluate the effects of dust on natural ecosystems

## (2) ポスト GCOE プロジェクト (乾燥地科学)

本事業は、乾燥地研究センターを中心に実施した、文部科学省事業・グローバル COE プログラム「乾燥地科学拠点の世界展開」(平成 19 年度～平成 23 年度)で形成された拠点機能をさらに発展、向上させるため、鳥取大学独自の事業として、平成 24 年度から学際的なプロジェクト「ポスト GCOE プロジェクト (乾燥地科学)」を実施している (プロジェクトリーダー: 恒川篤史)。

### プロジェクトの目標

本事業では、以下の 3 つを目標に推進している。

- ① 世界に通用する人材の育成  
ポストドク、博士課程学生を中心とした若手研究者に対し、英語学術論文記述法研修の実施、国内・海外学会発表、海外調査の機会を与えるなどのメニューを準備し、研究力、現場力、語学力を持った人材を輩出する (人材育成リーダー: 北村義信)。
- ② 乾燥地における人と自然の持続性の維持・向上に貢献できる研究の推進・研究成果の発信  
グローバル COE プログラムで実施した、砂漠化土地の環境修復に関する研究、乾燥地における持続的農業生産に関する研究などを継続実施し、得られた成果の発表を行うとともに、乾燥地の現場へ普及を図る。また、共同研究、他のプロジェクトとの連携研究も効果的に機能させ、独創的な研究成果を積極的に発信する。
- ③ 国際学術ネットワークの強化  
乾燥地の現場と連携し、グローバルに活躍する人材の育成と国際共同研究の推進を図る。

### 研究活動

グローバル COE プログラムで形成された以下の 5 研究グループにおいて引き続き研究を進展させる。

- 分子育種グループ (リーダー: 辻本壽)  
グローバル COE プログラムで開発した遺伝子組換え系統および異種遺伝子保有系統の耐寒性の評価を現場において行い、有効性を調査する。
- 農業生産グループ (リーダー: 山本定博)  
乾燥地における持続的農業生産に関する基礎研究及び現地、特に中国山東省での応用研究を継続する。
- 保健医学グループ (リーダー: 黒沢洋一)  
黄砂の生体影響の解明と警報システム構築および発生源対策のための研究拠点をさらに発展させる。
- 地球環境グループ (リーダー: 篠田雅人)  
モンゴルにおける観測・調査を継続し、地表面状態が黄砂発生の際風速に及ぼす影響評価を高度化し、黄砂発生ハザードマップを作成・公開する。
- 環境修復グループ (リーダー: 山中典和)  
グローバル COE プログラムで実施した砂漠化土地の環境修復に関わる研究について引き続き実施し、得られた成果の発表を行う。

## (2) Post-GCOE Project (Dryland Science)

Tottori University had conducted MEXT-funded project, Global COE Program “Global Center of Excellence for Dryland Science,” from FY 2007 to FY 2011, mainly led by the Arid Land Research Center. In order to further enhance the functions as the hub research institution, Tottori University has been conducting a multidisciplinary project in its own style, “Post-GCOE Project (Dryland Science)” since FY 2012. (Project Leader: Tsunekawa, A.)

This project promotes activities based on the following three goals”

- ① Foster human resources who are internationally active  
Produce talented personnel who have research competencies, practical abilities and linguistic skills by providing young researchers with opportunities such as a training course of writing English papers, overseas surveys, presentations at international conferences, etc. (Personnel Development Leader: Kitamura, Y.)
- ② Promote research for supporting sustainability of the nature-society system in drylands and release research achievements  
Conduct research on environmental restoration of desertified lands and sustainable agricultural production, publish the research outcomes on peer reviewed journals or books, and put the outcomes into practical use in arid regions. Promote joint and collaborative research with other national and international research institutions, and actively release unique research achievements to the public.
- ③ Strengthen the global academic network  
Develop world-class human resources and promote international joint researches through collaboration with overseas research institutions that hold the fields of drylands.

### Research Activity

- Molecular Breeding Group (Leader: Tsujimoto, H.)  
Evaluate and investigate drought tolerance of transgenic lines and heterologous genes lines, which were developed during the time of Global COE Program in the fields of drylands.
- Agricultural Production Group (Leader: Yamamoto, S.)  
Continue the basic research on sustainable agricultural production and the applied research in Shandong Province which have been conducting since the time of Global COE Program.
- Health and Medicine Group (Leader: Kurozawa, Y.)  
Develop a research center to analyze effects of Asian dust on health, establish an alarm system, and monitor and control source of dust emission.
- Global Environment Group (Leader: Shinoda, M.)  
Conduct observation and study in Mongolia, sophisticate the environmental estimation of the wind velocity of dust emission which is affected by ground surface, and create and publish a dust hazard map.
- Environment Restoration Group (Leader: Yamanaka, N.)  
Continually conduct research on environmental restoration of desertified lands which started under the Global COE Program, and publish the achievements on peer reviewed journals and books.

平成 25 年度における主な経費使用実績は以下のとおりである。

- プロジェクト研究員人件費 2 名
- 外国旅費 9 名
  - ・ 外国人研究者の研究打合せ招聘
  - ・ 研究調査
  - ・ UNCCD COP11 ブース出展参加
- 英語学術論文記述法研修 12 名
- 英文論文校正支援 6 名
- グローバル COE プログラム成果報告書作成

その他、研究活動等に必要な物品費、等

### (3) 卓越した大学院拠点形成支援補助金

鳥取大学は、昨年度に続き、文部科学省の平成 25 年度研究拠点形成費等補助金「卓越した大学院拠点形成支援補助金」に採択された。本補助金は、優秀な学生をひきつけ、世界で活躍できる研究者を輩出する環境作りを推進することを目的として、優れた研究基盤を活かし高度な教育と研究を融合する卓越した拠点を有する大学に対し、博士課程の学生が学修研究に専念する環境を整備するため実施された事業である。

鳥取大学は平成 19 年度～平成 23 年度に実施したグローバル COE プログラム「乾燥地科学拠点の世界展開」の中間評価が A 評価であったこと等、本補助金事業の申請要件を満たしていたことから、平成 24 年 10 月に申請し、同年 12 月に採択されていた。

本補助金の平成 25 年度における主な経費使用実績は以下のとおりである。

- 博士課程学生のリサーチ・アシスタント雇用 6 名
- 外国旅費 16 名
  - ・ 外国人研究者等のセミナー招聘
  - ・ 学会発表
  - ・ 研究調査
  - ・ 蘭州（中国）ワークショップ参加
- 国内旅費 5 名
  - ・ 学会参加

その他、博士課程における教育研究指導に必要な物品費、等

The major expenses spent in FY 2013 were as shown below.

- Employment of post-doctoral researchers
- Overseas travel expenses
  - ・ Invitation of researchers from overseas to hold meetings
  - ・ Field survey
  - ・ UNCCD COP11 Exhibition
- English scientific paper writing training course
- English editing for publication
- Report for the Global COE Program

Others were costs of materials, consumables, etc., which were necessary for Post-GCOE project's research activities.

### (3) MEXT Grants for Formation and Development of the Outstanding Hub Graduate Schools

Tottori University was selected by MEXT for an “MEXT Grant for Formation and Development of the Outstanding Hub Graduate Schools,” a subsidy for the cost of forming its research center, in FY 2012 and FY 2013. This subsidy is a project established for the purpose of promoting the creation of environments that will attract top students and nurture researchers qualified to be active around the world, by encouraging the formation of environments for students in Doctoral courses to specialize in their academic research at universities with superior centers that take advance of their first-class research infrastructures to combine advanced education and research.

Tottori University applied in October 2012 and was accepted in December of the same year, when it had satisfied essential conditions to apply for the subsidy by, for example, receiving an A grade in an interim evaluation for its Global COE Program, “Global Center of Excellence for Dry Land Science,” which it implemented from FY 2007 to FY 2011.

The major expenses covered by the subsidy in FY 2013 were as shown below.

- Employment of doctoral students as research assistants
- Overseas travel expenses
  - ・ Invitation of researchers from overseas to hold seminars
  - ・ Conference presentation
  - ・ Field survey
  - ・ Lanzhou workshop
- Travel expenses in Japan
  - ・ Conference presentation

Others were costs of materials, consumables, etc., which were necessary for research and educational guidance in doctoral courses.

### 1.3 共同研究 / Joint Research

#### (1) 重点研究 / Focused Research

重点研究 1 Focused Research 1		対応教員 Corresponding Staff	辻本 壽 Tsuji moto, Hisashi
研究代表者 Principal Researchers	明石 欣也 (鳥取大学農学部) Akashi, Kinya (Faculty of Agriculture, Tottori University)		
研究課題 Research Subject	悪環境下におけるジャトロファ花成・登熟および代謝調節技術によるバイオ燃料生産強化のシステム開発 A systematic approach for the fortification of biodiesel production via engineering of flowering, fruit maturation and metabolic control in <i>Jatropha</i> under adverse environmental conditions		
研究分担者 Co-researchers	アミン エリタエブ (鳥取大学乾燥地研究センター)、留森 寿士 (鳥取大学乾燥地研究センター)、坪 充 (鳥取大学乾燥地研究センター)、安藤 孝之 (鳥取大学乾燥地研究センター)、恒川 篤史 (鳥取大学乾燥地研究センター) Amin Eltaybe (Arid Land Research Center, Tottori University) Tomemori, Hisashi (Arid Land Research Center, Tottori University) Tsubo, Mitsuru (Arid Land Research Center, Tottori University) Ando, Takayuki (Arid Land Research Center, Tottori University) Tsunekawa, Atsushi (Arid Land Research Center, Tottori University)		
共同研究要旨 Summary of Joint Research	<p><i>Jatropha</i> is a drought-resistant plants and produces oil-rich seeds, thus it has been proposed as a next-generation biofuel crop in the arid zones. In this study, we performed 1) isolation of genes related to stress-resistance from wild watermelon, 2) functional analysis of <i>JcDGAT1</i> in <i>Jatropha</i>, 3) optimization of <i>Agrobacterium</i>-mediated transformation for molecular breeding of <i>Jatropha</i>.</p> <p>In wild watermelon, a transcriptome profile under drought/high light conditions was analyzed by microarray analysis, resulting in the isolation of a transcription factor <i>CLZFB1</i>. Overexpression of <i>CLZFB1</i> in wild watermelon hairy roots and <i>Arabidopsis</i> plants stimulated enhanced root-growth, suggesting that <i>CLZFB1</i> is one of the key regulators for root growth maintenance under water deficit condition.</p> <p>Diacylglycerol acyltransferase (<i>DGAT</i>) is a rate-limiting step in triacylglycerol biosynthesis, hence is an important target for genetic manipulation. We isolated a cDNA for <i>DGAT</i> (<i>JcDGAT1</i>) from <i>Jatropha</i>. Real-time RT-PCR analysis revealed that <i>JcDGAT1</i> was strongly up-regulated at the final stage of fruit maturation. Functionality of <i>JcDGAT1</i> cDNA was confirmed by complementation assay using a yeast <i>H1246α</i> quadruple mutant.</p> <p>To optimize transformation protocol of <i>Jatropha</i>, we conducted a <math>\beta</math>-glucuronidase (<i>GUS</i>) assay under various co-culture conditions. The highest frequency of <i>GUS</i>-positive explants (<math>93.0 \pm 23.6\%</math>) was obtained using vacuum infiltration of an <i>Agrobacterium</i> suspension combined with co-cultivation on filter-paper wicks moistened with a co-culture medium instead of solid medium. As a visible marker, we used a variant of the green fluorescent protein gene <i>Venus</i>, which had an advantage for detecting transgenic shoots. The transformation efficiency was improved to 20%, which is sufficient for practical use. Using this protocol, transgenic <i>Jatropha</i> shoots overexpressing trehalose biosynthesis genes for stress-tolerance by were obtained.</p>		
重点研究 2 Focused Research 2		対応教員 Corresponding Staff	恒川 篤史 Tsunekawa, Atsushi
研究代表者 Principal Researchers	福井 希一 (大阪大学工学研究科) Fukui, Kiichi (Graduate School of Engineering, Osaka University)		
研究課題 Research Subject	環境ストレス耐性向上のための形質転換植物の作製及び DNA マーカーを用いた在来・野生系統の選抜と環境再現装置を用いた耐環境ストレス能の評価 Production of genetically-engineered plants and selection of native or wild lines for improvement of the stress tolerance, and evaluation of the tolerance by using environment simulators		
研究分担者 Co-researchers	辻本 壽 (鳥取大学乾燥地研究センター)、酒井 啓江 (大阪大学工学研究科)、モハメド アーメド (大阪大学工学研究科)、ビクター ペシナ キンテロ (INIFAP CIRCE)、レオバルド イラチュエタドンファン (INIFAP CIRPAS)、ホセ ルイス ソリス ボニリヤ (INIFAP CIRPAS)、安藤 孝之 (鳥取大学乾燥地研究センター)、辻 渉 (鳥取大学農学部)、竹本 高広 (大阪大学工学研究科)、笹井 智博 (大阪大学工学研究科)、アルフレド ザマリバ コルメネロ (INIFAP CIRPAS)、土本 卓 (大阪大学工学研究科)、ホセ ルイス アナヤ ロペス (INIFAP CIRCE)、井上 知恵 (鳥取大学乾燥地研究センター)、留森 寿士 (鳥取大学乾燥地研究センター) Tsuji moto, Hisashi (Arid Land Research Center, Tottori University) Sakai, Hiroe (Graduate School of Engineering, Osaka University) Mohammed Ahmed (Graduate School of Engineering, Osaka University) Victor Pecina Quintero (INIFAP CIRCE) Leobardo Iracheta Donjuan (INIFAP CIRPAS) José Luis Solís Bonilla (INIFAP CIRPAS) Ando, Takayuki (Arid Land Research Center, Tottori University) Tsuji, Wataru (Faculty of Agriculture, Tottori University) Takemoto, Takahiro (Graduate School of Engineering, Osaka University) Sasai, Tomohiro (Graduate School of Engineering, Osaka University) Alfredo Zamarripa Colmenero (INIFAP		

	CIRPAS) Tsuchimoto, Suguru (Graduate School of Engineering, Osaka University) José Luis Anaya López (INIFAP CIRCE) Inoue, Tomoe (Arid Land Research Center, Tottori University) Tomemori, Hisashi (Arid Land Research Center, Tottori University)
共同研究要旨 Summary of Joint Research	<p>First, a DNA construct to overexpress the jatropha JcNF-YB6 gene was introduced in jatropha explants, and the callus was formed in the selection medium. JcNF-YB6 is the jatropha ortholog of Arabidopsis AtNF-YB1. Because AtNF-YB1 was shown to improve drought tolerance when overexpressed in the transgenic jatropha last year, more effects are expected in JcNF-YB6. Second, we obtained four lines of transgenic jatropha that overexpress the Jatropha JcPPAT gene. JcPPAT is the jatropha ortholog of AtPPAT, which was shown to improve drought tolerance when overexpressed in the transgenic jatropha last year, like AtNF-YB1. We detected the transgene in all the plants, and expression of the transgene in three out of four plants. Third, we quantified expression of the transgene in three lines of the JcNF-YB1 transgenic plants by Real-time PCR. JcNF-YB1 is a jatropha ortholog of AtNF-YB3, which is involved in ER-stress response. We found that the highest expression level was about twice as high as the lowest. Because we did not have enough number of cuttings of the new transgenic plants described above, we did not do the drought tolerance experiment in the simulator this year. On the other hand, transgenic plants that was used for drought tolerance experiment last year were reexamined in Tottori University, and then were moved to Arid Land Research Center, to obtain flowers and fruits, and to prepare for variety registration.</p> <p>Other than production and analysis of transgenic plants, Tsuchimoto, a project member, did field investigation of jatropha and jojoba, another drought-tolerant oil crop, in Sudan. We also found that Mexican accessions showed polymorphism not only by SSR markers, but also by retrotransposon markers. We also succeeded to measure degree of unsaturation of jatropha oil in living seeds by the newly-developed non-linear laser microscopy.</p>

重点研究 3 Focused Research 3	対応教員 Corresponding Staff	山中 典和 Yamanaka, Norikazu
研究代表者 Principal Researchers	金 紅実 (龍谷大学政策学部) Jin, Hongshi (Faculty of policy Science, Ryukoku University)	
研究課題 Research Subject	中国の西部乾燥地域における鉱山資源開発と植生回復政策の執行過程における仕組みと現状に関する研究—内モンゴル自治区烏海市を事例に— A study on the enforcement process and the mechanism, current state of mineral resources development and vegetation recovery policy in arid areas of western China	
研究分担者 Co-researchers	窪田 順平 (総合地球環境学研究所研究部)、北川 秀樹 (龍谷大学政策学部) Kubota, Jumpei (Research Institute for Humanity and Nature) Kitagawa, Hideki (Faculty of Policy Science, Ryukoku University)	
共同研究要旨 Summary of Joint Research	While a lot of arid lands restoration programs are enforced by national key project, Wuhai was one of the rare cases that local government was able to fully exercise its autonomy, relying on the financial strength and economic strength and regional superiority of rights of access to the Yellow River. The program is not only a part of the critical public services involving the right to live of local inhabitants, but also is the result of ability to provide local public services of local government intensified. During the process, national urban greening campaign was enforced linked with personnel management of the Communist Party, and a top-down community participation was applied represented by a tree-planting duty system. However, obviously, instruments to internalize lands restoration responsibility of mining industry as the local main industry did not function very well, and protections of competitiveness and economic efficiency of enterprises have been carried out on the top priority basis.	

## (2) 一般研究 / General Research

一般研究 1 General Research 1	対応教員 Corresponding Staff	篠田 雅人 Shinoda, Masato
研究代表者 Principal Researchers	山下 博樹 (鳥取大学地域学部) Yamashita, Hiroki (Faculty of Regional Sciences, Tottori University)	
研究課題 Research Subject	アメリカ合衆国南西部における都市開発の多様性と小規模中心地の盛衰に関する研究 The diversity of urban developments and vicissitude of the small centers in the south-western part of USA	
共同研究要旨 Summary of Joint Research	The objective of this study is to clarify the diversity of urban developments and the prosperity and decline of small centers in the south-western part of the USA. I studied about the diversity of cities, and the characters of about the 130 ghost towns in Arizona State.	

一般研究 2 General Research 2		対応教員 Corresponding Staff	篠田 雅人 Shinoda, Masato
研究代表者 Principal Researchers	三上 正男 (気象庁気象研究所) Mikami, Masao (Japan Meteorological Agency Meteorological Research Institute)		
研究課題 Research Subject	北東アジア半乾燥地帯における黄砂発生メカニズムの機構解明に関する観測的研究 Observation on dust emission processes on semi-arid region in Northeastern Asia.		
研究分担者 Co-researchers	石塚 正秀 (香川大学工学部) 山田 豊 (理化学研究所先端工作支援チーム) Ishizuka, Masahide (Faculty of Engineering, Kagawa University) Yamada, Yutaka (RIKEN Advanced Manufacturing Team)		
共同研究要旨 Summary of Joint Research	<p>We have conducted an experiment on the relation between surface crust and dust emission at TsogtOvoo in Mongolia from middle April to the end of May. Experiments were made for hardness of crust, relation between crust hardness and the depth, water infiltration process, soil surface hardness due to the presence of surface crust, water supply effect on soil surface hardness, crust formation by water and soil supply to the surface, pH and EC measurements within soil layer. We have found that the surface crust becomes hard when water is supplied to the surface soil layer.</p> <p>For understanding the relation between year-by-year hydrological condition and resultant soil surface condition, an analysis was made using long-term</p>		
一般研究 3 General Research 3		対応教員 Corresponding Staff	篠田 雅人 Shinoda, Masato
研究代表者 Principal Researchers	飯島 慈裕 (独立行政法人海洋研究開発機構地球環境変動領域・北半球寒冷圏研究プログラム) Iijima, Yoshihiro (Japan Agency for Marine-Earth Science and Technology Research Institute for Global Change)		
研究課題 Research Subject	気候傾度に沿ったカザフスタン—モンゴルステップトランセクトにおける草原生態系変動 Grassland dynamics in relation to climatic gradients in trans-steppe transect from Kazakhstan to Mongolia.		
共同研究要旨 Summary of Joint Research	<p>Integrated observation on meteorological, soil and vegetation components have continued at Kazakhstan-Mongolian grassland (1 station at Kazakhstan and 4 stations at Mongolia: adding a new station at Terej). We set up new meteorological observation system including interval camera in July 2013 at Terej and Bulgan in Mongolia. Data are also transferred through the ARGOS data transfer system and obtained data based on quasi real-time data acquisition was analyzed to exhibit the winter climate in Kazakh-Mongolia steppe. According to the field observation and radio sonde data, periodic intrusion of cold air mass after November 2012 occurred with historically minimum air temperature during winter in Mongolia. Cold air mass events occurred twice in December. These events were resembled to WACS (Warm Arctic Cold Siberia) pattern in response to the expansion of high pressure anomaly in the Barents Sea; that is, the low-temperature anomaly propagated from Central Asia to Mongolia. Along with the cold air advection, the low temperature peak between Japan and Mongolia showed time difference of about three days in both cases. Based on air temperature and wind profiles in Mongolia in 22 to 24 December and 1 January, upper air temperature was greatly reduced in conjunction with intensifying wind speed at lower troposphere which caused decaying inversion layer near the ground. It suggests that cold air advection in upper free air was main factor to affect strong cold air event from Central Asia through Mongolia to Japan.</p>		
一般研究 4 General Research 4		対応教員 Corresponding Staff	篠田 雅人 Shinoda, Masato
研究代表者 Principal Researchers	北川 博史 (岡山大学大学院社会文化科学研究科) Kitagawa, Hirofumi (Graduate School of Humanities and Social Sciences, Okayama University)		
研究課題 Research Subject	乾燥地都市における経済開発とその特性—北米地域を事例として— Economic Development and its Character in Arid Land -A Case Study on Cities in North America-		
共同研究要旨 Summary of Joint Research	<p>In order to examine this research project, we investigated the features of economic development in Phoenix metropolitan area and Tucson metropolitan area in Arizona State. The population of these metropolitan areas has increased rapidly after 1990 s. In these regions, there was the agglomeration of ICT industries and it had the industrial structure which is suitable for the environment of arid land.</p>		
一般研究 5 General Research 5		対応教員 Corresponding Staff	篠田 雅人 Shinoda, Masato
研究代表者 Principal Researchers	立入 郁 (独立行政法人海洋研究開発機構地球環境変動領域) Tachiiri, Kaoru (Research Institute for Global Change, Japan Agency for Marine-Earth Science and Technology)		



研究課題 Research Subject	モンゴル草原地域における放牧圧の推定とその陸域生態系モデルへの導入 Estimating grazing pressure in Mongolian grasslands and its incorporation to a terrestrial ecosystem model
共同研究要旨 Summary of Joint Research	<p>In this year, using CENTURY 4 (<a href="http://www.nrel.colostate.edu/projects/century/">http://www.nrel.colostate.edu/projects/century/</a>) model considering flows of nitrogen and other matters, we carried out the comparison among Case 1: no grazing, Case 2: grazing (but only removing above ground biomass), and Case 3: grazing (soil fertilization by livestock manure is considered), by using the default setting representing grassland in central US. The calculation of Case 2 is carried out by giving zero to the parameter determining the fraction of the returned carbon/nitrogen/phosphorus/sulfur to soil out of those removed from vegetation.</p> <p>As the result of running CENTURY for 2000 years, we found the significant biomass reduction in Case 2, only considering removal of aboveground biomass, but when we consider the soil fertilization by manure (Case 3), significant part of the reduction is compensated by the fertilization and become close to the no grazing case. Looking at the average of biomass in 1501–2000 th years, that of Case 3 is 20% smaller than Case 1, which is significantly more moderate than Case 2 of 64% decrease.</p> <p>In addition, we examine the effect of varying default values in input air temperature and precipitation. We tested <math>\pm 1^{\circ}\text{C}</math> varying for temperature, and <math>\pm 20\%</math> for precipitation (and for precipitation we also tested <math>\pm 50\%</math> change for standard deviation), and found that the recovery rate, calculate as <math>(\text{Case 2} - \text{Case 3})/(\text{Case 1} - \text{Case 3})</math> is almost unchanged (as 0.68–0.69) for all cases. From this we can conclude that the recovery effect of soil fertilization by livestock manure in biomass is robust. It will be need to test the similar experiment using parameter sets representing other regions, e.g. Mongolian grassland, and examine if the result depends on the change of condition.</p>

一般研究 6 General Research 6	対応教員 Corresponding Staff	篠田 雅人 Shinoda, Masato
研究代表者 Principal Researchers	木村 圭司 (北海道大学大学院情報科学研究科) Kimura, Keiji (Graduate School of Information Science and Technology, Hokkaido University)	
研究課題 Research Subject	夏季モンゴルにおける低気圧・前線の構造と降水量変動に関する研究 A study of precipitation variation in relation to the structure of cyclones and fronts in summer Mongolia	
共同研究要旨 Summary of Joint Research	<p>A rainfall phenomenon in summer Mongolia is analyzed with some examples about movement of cyclone and the water vapor transportation, and the characteristic is clarified. The analyzed data are precipitation/sea surface pressure, the absolute water vapor contents/temperature/wind velocity (U, V) of 850 hPa. Study period is in the summer (from May to September) between 1979 and 2012. Weather chart of every day is made and analyzed it about the movement of the cyclone/front and the distribution of the water vapor transportation. Along the 50/45/40 degrees N in Mongolia, the cross sections of precipitation at the altitude-time (Hovmöller Diagram) and the cross section of water vapor transportation in some spots at the latitude-time were drawn and clarified the characteristic.</p> <p>As a result, more rainfall was shown in the southern area, and little was shown in the northern area in Mongolia. The distribution was able to confirm with northern taiga and southern desert. Especially, rainfall in August, 2000 was analyzed as typical examples. The water vapor transportation flux was seen eastward with the moving of cyclone/fronts. The water vapor rarely came from the south in the western Mongolia, and the water vapor came from both the north and the south. Cyclones moves eastward several times in a month and precipitation.</p>	

一般研究 7 General Research 7	対応教員 Corresponding Staff	篠田 雅人 Shinoda, Masato
研究代表者 Principal Researchers	中野 智子 (中央大学経済学部) Nakano, Tomoko (Faculty of Economics, Chuo University)	
研究課題 Research Subject	土壌の凍結・融解にともなう CO <sub>2</sub> 放出の測定 Soil CO <sub>2</sub> emission during freezing-thawing cycles	
共同研究要旨 Summary of Joint Research	<p>The final goal of our study is to evaluate the annual CO<sub>2</sub> budget between the atmosphere and semiarid grassland ecosystems. We conducted field measurements of CO<sub>2</sub> fluxes in Mongolian steppe grasslands during plant growing seasons from 2004 to 2011. In general, soil CO<sub>2</sub> emission in winter time is considered negligible. However, recent studies reported that some microbes can act in frozen soils and CO<sub>2</sub> could burst from soil surface to atmosphere during soil freezing-thawing cycles. Therefore it is important to clarify CO<sub>2</sub> emission from grassland soils in a non-growing season. In the present joint study, aiming at evaluating the amount of CO<sub>2</sub> efflux from soil surface to atmosphere and examining controlling factors of the emission, we conducted an experiment in the cold desert simulation chamber of ALRC. We controlled air temperature in the chamber to change from <math>-10^{\circ}\text{C}</math> to <math>10^{\circ}\text{C}</math> in cycles of 24 hours' duration and measured CO<sub>2</sub> flux from soil</p>	

	samples every thirty minutes by using an automated closed chamber system. The results showed that values of CO <sub>2</sub> flux were constantly positive, indicating that CO <sub>2</sub> emitted consistently from the soil samples even they were frozen. However, we did not find clear CO <sub>2</sub> burst and CO <sub>2</sub> variation corresponding to the temperature change.
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一般研究 8 General Research 8	対応教員 Corresponding Staff	木村 玲二 Kimura, Reiji
研究代表者 Principal Researchers	多炭 雅博 (宮崎大学農学部) Tasumi, Masahiro (Faculty of Agriculture, University of Miyazaki)	
研究課題 Research Subject	黄砂発生源における蒸発散量推定技術の適用評価について Evaluation of evapotranspiration estimation technique for yellow-dust monitoring	
共同研究要旨 Summary of Joint Research	<p>This research focused on a large-scale soil moisture estimation using satellite remote-sensing as a tool of monitoring water environment for yellow-dust production areas in arid and semi-arid lands. In this year, we have conducted (1) field experiment for detailed understandings of the relationship between soil moisture and surface temperature; and (2) accuracy assessment of the proposed evapotranspiration/soil moisture estimation model. The results were presented in (1) 21 st Annual congress of Japan Rainwater Catchment Systems association, and (2) International Symposium on Agricultural Meteorology 2014.</p> <p>According to the field experiment, it was found that surface temperature decreases as soil moisture increases up to a certain 'threshold' of the soil moisture level. Once the soil moisture exceeds the threshold, the change of soil moisture does not appear to the surface temperature. The result agreed with the assumption employed to the proposed model. Accuracy assessment was conducted using flux measurement data obtained by AsiaFlux Database (Kherlenbayan Ulaan site of Mongolia). Although some uncertainties remained on the assessment due to data lacking and errors in the observed flux data, estimated evapotranspiration fairly agreed with the observed evapotranspiration in annual bases (0-14% error) in four out of five evaluated years, indicating a good potential of the proposed model.</p>	

一般研究 9 General Research 9	対応教員 Corresponding Staff	木村 玲二 Kimura, Reiji
研究代表者 Principal Researchers	加藤 博 (一橋大学大学院経済学研究科) Kato, Hiroshi (Graduate School of Economics, Hitotsubashi University)	
研究課題 Research Subject	乾燥地エジプトの灌漑耕作システムの学際的研究 Multi-disciplinary study of irrigation and cultivation system of arid land, case of Egypt	
研究分担者 Co-researchers	長谷川 奏 (早稲田大学エジプト学研究所) 岩崎 えり奈 (共立女子大学文芸学部) 松岡 延浩 (千葉大学大学院園芸学研究科) サルワ エルベイ (リモートセンシング空間科学国立研究所) 藤巻 晴行 (鳥取大学乾燥地研究センター) サイエド ザゲルール (リモートセンシング空間科学国立研究所) Hasegawa, So (Institute of Egyptology, Waseda University) Iwasaki, Erina (Faculty of Arts and Letters, Kyoritsu Women's University) Matsuoka, Nobuhiro (Graduate School of Horticulture, Chiba University) Salwa Elbeih (National Authority for Remote Sensing and Space Sciences) Fujimaki, Haruyuki (Arid Land Research Center, Tottori University) Sayeed Zaghoul (National Authority for Remote Sensing and Space Sciences)	
共同研究要旨 Summary of Joint Research	<p>The field work could not be executed this year because of the unstable political situation after the Egyptian Revolution. Therefore, we focused our research in the analysis of the data and information collected until now, and presented our research results in the Second Annual Conference of ANGIS (Asian Network for GIS-based Historical Studies (Japan): Hiroshi Kato and Erina Iwasaki, "GIS as a Tool of Linking Different Socioeconomic Spaces: Study of Urban-Rural Migration to Cairo", Kotaro Mogi, Hiroomi Tsumura and So Hasegawa, "Quantitative assessment of an irrigation system in Nile Delta based on topographic variables with GIS", Kato H., Elbeih S.F., Iwasaki E., Sefelnasr A.M., Shalaby A.A. and E.A. Zaghoul, "The Relationship between Groundwater Resources, Land Use, and Demographic Characteristics, Using Remote Sensing and GIS Techniques, Dakhla Oasis, Egypt".</p>	

一般研究 10 General Research 10	対応教員 Corresponding Staff	木村 玲二 Kimura, Reiji
研究代表者 Principal Researchers	松岡 延浩 (千葉大学大学院園芸学研究科) Matsuoka, Nobuhiro (Graduate School of Horticulture, Chiba University)	

研究課題 Research Subject	エジプト西部砂漠のオアシスで行われている輪作体系に対する灌漑時期の最適化 Optimization of irrigation period for the crop rotation system in oasis of the Western Desert, Egypt
研究分担者 Co-researchers	加藤 博（一橋大学大学院経済学研究科）岩崎 えり奈（共立女子大学文芸学部）間野 正美（千葉大学大学院園芸学研究科） Kato, Hiroshi (Graduate School of Economy, Hitotsubashi University) Iwasaki, Erina (Faculty of Arts and Letters, Kyoritsu Women's University) Mano, Masayoshi (Graduate School of Horticulture, Chiba University)
共同研究要旨 Summary of Joint Research	From February 27 to March 9, 2014, we carried out field survey at Rashda village in New Valley Province of the Arab Republic of Egypt. Our results for wheat field in Rashda village show that 1) increase of the irrigation frequency brings increase in yield and 210 ton/ha irrigation during cultivation period obtain about 90% of the maximum yield for normal weather condition from growth simulation (Matsuoka et al., 2014) and 2) farmers apply once in 10 days and 1.5 hours border irrigation empirically by interview (Kato et al., 2011).

一般研究 11 General Research 11	対応教員 Corresponding Staff	辻本 壽 Tsujimoto, Hisashi
研究代表者 Principal Researchers	佐藤 和広（岡山大学資源植物科学研究所） Sato, Kazuhiro (Institute of Plant Science and Resources, Okayama University)	
研究課題 Research Subject	耐塩性オオムギの評価と遺伝子マッピング Evaluation and genetic mapping of salt tolerance in barley	
研究分担者 Co-researchers	久野 裕（岡山大学資源植物科学研究所） Hisano, Hiroshi (Institute of Plant Science and Resources, Okayama University)	
共同研究要旨 Summary of Joint Research	<p>1. Salt tolerant lines identified at Okayama University were planted at two dryland research stations (Kyzylorda and Almaty) in Kazakhstan. They showed poor growth compared to local elite cultivars due to different adaptive traits e.g. earliness. Crossing between local cultivars and salt tolerant lines is necessary to evaluate salt tolerance at local conditions. These salt tolerance lines will be evaluated again for next growing season.</p> <p>2. Salt tolerant lines identified at Okayama University and control lines are also evaluated by a desert simulator. However the reactions to drought condition were not clear among tolerant and control lines.</p> <p>3. To generate genetic markers between local cultivars at Kazakhstan and salt tolerant lines, RNA-seq analysis was conducted by a next generation sequencer at Tottori University. However, the system has several technical difficulties and did not produce enough data sets. Instead, a new sequencing system at Okayama University was applied and produced enough amount of sequence data which can be used for future marker development between parents.</p> <p>4. QTLs responsible for salt tolerance were detected by using a population between tolerant line and Haruna Nijo with 384 SNP markers distributed on the genome. Significant QTLs were identified on chromosomes 1H and 5H.</p>	

一般研究 12 General Research 12	対応教員 Corresponding Staff	辻本 壽 Tsujimoto, Hisashi
研究代表者 Principal Researchers	寺地 徹（京都産業大学総合生命科学部） Terachi, Toru (Faculty of Life Sciences, Kyoto Sangyo University)	
研究課題 Research Subject	葉緑体の形質転換技術を用いたストレス耐性コムギの作出 Production of stress tolerant wheat through the use of chloroplast transformation technology	
研究分担者 Co-researchers	山岸 博（京都産業大学総合生命科学部）辻村 真衣（京都産業大学総合生命科学部） Yamagishi, Hiroshi (Faculty of Life Sciences, Kyoto Sangyo University) Tsujimura, Mai (Faculty of Life Sciences, Kyoto Sangyo University)	
共同研究要旨 Summary of Joint Research	<p>It is well known that chloroplast transformation has some advantages over the conventional nuclear transformation; e.g. high-level transgene expression, a lack of gene silencing, and easiness of gene-containment due to maternal inheritance of plastid. However, in wheat, stable chloroplast transformation has not yet been achieved, mainly because it is difficult to obtain regenerable explant.</p> <p>In this co-operative research, we try to produce the stress tolerant wheat by introducing a gene encoding ascorbate peroxidase (APX) into chloroplast genome. APX is one of key enzymes forming ascorbate-gul-tathione cycle in chloroplast, and it actively scavenges reactive oxygen species (ROS) that are highly toxic to plant cells.</p> <p>In December 2013, plants (<i>Triticum aestivum</i> cv. Akadaruma) were grown in a growth chamber in ALRC, Tottori University, and 11,353 immature embryos were prepared from them. About 70% embryos became</p>	

callus. We delivered plasmid vector DNA containing apx to the callus by a particle bombardment system. Total DNAs were isolated from 16 calli that had survived and kept green spot after antibiotic selection. PCR assay showed amplification of a transgene in some calli, however, convincing evidence that the transgene was integrated into the chloroplast genome could not be obtained. Since proplastid in callus does not develop to chloroplast, we tried to find appropriate hormone conditions in which the callus generates green spots. Consequently, 70% of callus generated green spots in the subculture medium supplemented with NAA 0.2 mg/L and BAP 2 mg/L, and plasmid vector DNA was bombarded to the callus. The callus is being grown on the selection medium to check whether it was transformed or not.

一般研究 13 General Research 13	対応教員 Corresponding Staff	安 萍 An, Ping
研究代表者 Principal Researchers	杉本 幸裕 (神戸大学大学院農学研究科) Yukihiro, Sugimoto (Graduate School of Agricultural Science, Kobe University)	
研究課題 Research Subject	半乾燥地の主要作物と根寄生雑草の寄生関係成立要因に関する生理生化学的研究 Physiological and biochemical analyses of interactions between host and parasitic plants	
研究分担者 Co-researchers	水谷 正治 (神戸大学大学院農学研究科) 吉本 千壽 (神戸大学大学院農学研究科) 上野 琴巳 (神戸大学大学院農学研究科) 鮫島 啓彰 (神戸大学大学院農学研究科) Mizutani, Masaharu (Graduate School of Agricultural Science, Kobe University) Yoshimoto, Chizu (Graduate School of Agricultural Science, Kobe University) Ueno, Kotomi (Graduate School of Agricultural Science, Kobe University) Samejima, Hiroaki (Graduate School of Agricultural Science, Kobe University)	
共同研究要旨 Summary of Joint Research	<p>Pot and field experiments were conducted in Sudan using SATREPS1, NERICA5 and NERICA13, as Striga resistant upland rice in rhizotron, NERICA4 and NERICA18, as susceptible upland rice, and Nipponbare as an intermediate lowland rice. The maximum number of emergent Striga per pot was 0, 0.5, 2.5, 4.7, 6.7 and 13.0 for SATREPS1, NERICA5, NERICA13, Nipponbare, NERICA4 and NERICA18, respectively. In the field, the maximum number of emergent Striga per 10 rice hills was 2.0, 2.0, 4.8, 18.3, 13.5 and 13.5, respectively. Striga reduced shoot DW by 12, 21, 30, 43, 74 and 70%, respectively, in the pot experiment. In the field experiment, Striga had no significant adverse effects on shoot DW of the rice varieties, SATREPS1, NERICA5 and NERICA13. However, the parasite reduced shoot dry weight of Nipponbare, NERICA4 and NERICA18 by 45, 60 and 43%, respectively. These findings indicate that SATREPS1 and NERICA5 have Striga resistance not only at the beginning of their vegetative growth stage in rhizotron but also throughout the growth duration in pots and fields under the outdoor conditions of Sudan. Previously, we found that two thirds of Striga that developed shoots on SATREPS1 died in rhizotron. In the present study, no Striga emerged in the pots of SATREPS1 and several Striga that came out from under SATREPS1 died immediately after their emergence in the field. These findings suggest that SATREPS1 possesses mechanism(s) that inhibit Striga growth after establishment of parasitism.</p>	

一般研究 14 General Research 14	対応教員 Corresponding Staff	安 萍 An, Ping
研究代表者 Principal Researchers	阿部 淳 (東京大学大学院農学生命科学研究科) Abe, Jun (Graduate School of Agricultural and Life Sciences, The University of Tokyo)	
研究課題 Research Subject	ヤトロファ ( <i>Jatropha curcas</i> ) の根の形態学的特性と環境応答に関する研究 Study on morphological structure and environmental responses of roots in <i>Jatropha curcas</i>	
共同研究要旨 Summary of Joint Research	<p>The root system of <i>Jatropha curcas</i> consists of the tap root and four roots that emerge just after germination. Microscopic observation indicated that the four roots are not lateral roots of the tap root; they are adventitious roots formed at the base of hypocotyl. With soil drought treatment up to pF 2.8 in a pot experiment, seedlings of <i>J. curcas</i> declined the shoot biomass significantly but maintained the dry weight and total length of roots. In another pot experiment, effects and interaction of water stress (drought stress) and nutrient deficiency were investigated. Both the drought and nutrient deficiency decreased shoot biomass of <i>J. curcas</i> to some extent, while the combination of those two stresses much declined the shoot biomass. It has been expected to utilize <i>J. curcas</i> plants for the greening of abandoned lands with providing the method for family income to rural people, because <i>J. curcas</i> is thought a highly tolerant plant against soil environmental stresses. The present study, however, suggested that combined stress of drought and nutrient deficiency can strongly suppress the shoot growth of <i>J. curcas</i> seedlings, though the root system of <i>J. curcas</i> seems rather tolerant to such stresses. Further study on the response of <i>J. curcas</i> to combined soil stresses is required to apply this plant species effectively for greening.</p>	

一般研究 15 General Research 15		対応教員 Corresponding Staff	安 萍 An, Ping
研究代表者 Principal Researchers	本間 知夫 (前橋工科大学工学部生物工学科) Homma, Tomoo (Department of Biotechnology, Maebashi Institute of Technology)		
研究課題 Research Subject	マングローブ植物根系の耐塩性機構の解剖生理学的解析 Anatomical and physiological analysis of salt tolerance in mangrove roots		
研究分担者 Co-researchers	地下 まゆみ (大阪大谷大学教育学部) Jige, Mayumi (School of Education, Osaka Ohtani University)		
共同研究要旨 Summary of Joint Research	Seedlings of <i>Kandelia obovata</i> were cultivated under different kinds of soil condition (sand, black soil, or Kanuma pumice) with water, and their root growth & surface structure were observed and compared by using scanning electron microscopy (SEM). Soil condition (particle size and its packing condition) affected root growth, that is, numbers, length, and thickness of thick or thin white roots were different. Roots became thinner & longer under black soil (loosed) condition, but shorter & thicker under sand (packed) condition. By comparing with SEM images, surface condition of roots grown under sand was rough, but that under black soil was smooth. About physiological analysis of salt tolerance in root system, electric potential & capacitance measurement was tried using tomato plants instead of mangrove ones as preliminary experiment.		
一般研究 16 General Research 16		対応教員 Corresponding Staff	安 萍 An, Ping
研究代表者 Principal Researchers	柏木 純一 (北海道大学農学研究院生物資源生産学部門) Kashiwagi, Junichi (Graduate School of Agriculture, Hokkaido University)		
研究課題 Research Subject	コムギの乾燥抵抗性改善のための乾燥回避性形質の特定 Identifying relevant drought avoidance traits to improve the wheat productivity under drought environments		
研究分担者 Co-researchers	三島 悠輔 (北海道大学大学院農学研究院) Mishima, Yusuke (Graduate School of Agriculture, Hokkaido University)		
共同研究要旨 Summary of Joint Research	<p>The aim of this collaborative research was to improve the drought tolerance in wheat.</p> <p>[Materials and Methods] The trial was conducted under a rain-out shelter to create drought environments. Diverse hexa- and tetra- ploid wheat germplasm, SW10, SW15, SW20, Cham1, Cham6 (ICARDA-Syria), Harukirari, Norin61, Sanukinoyume, Nishihonami, Haruyokoi (Japan), ET23 (Ethiopia), Haurari (tetraploid wheat) was used for investigating the relevant trait(s) to improve the drought tolerance in wheat crop. The trial was started on 9 May 2013 in two irrigation treatments (well-irrigated and drought treatments) with 3 replications. The agronomic traits were measured periodically during the trial period, and the yield and its components were recorded at the maturity. The WUE was evaluated at the maturity by measuring the <sup>13</sup>C discrimination.</p> <p>[Results and discussions] The SW10 and SW20 were two genotypes showed the largest grain yield in the drought treatment. As these genotypes were developed in Syria where the drought intensity was very severe, it was interesting that they showed better yield even under moderate drought environment created in this trial. In this trial, the drought tolerant wheat genotypes showed unique characteristics that were to produce greater grain quantity through more productive tiller productions compared to the drought susceptible one. Further physiological studies for productive tiller developments are needed.</p>		
一般研究 17 General Research 17		対応教員 Corresponding Staff	安 萍 An, Ping
研究代表者 Principal Researchers	松添 直隆 (熊本県立大学環境共生学部) Matsuzoe, Naotaka (Faculty of Environmental & Symbiotic Sciences, Prefectural University of Kumamoto)		
研究課題 Research Subject	底面給水型水耕栽培装置を用いた作物の蒸発散モデル構築に関する研究 Modeling of crop evapotranspiration used the closed hydroponics system with capillary uptake method		
研究分担者 Co-researchers	近藤 謙介 (鳥取大学農学部) 中嶋 康博 (熊本県立技術短期大学校情報通信技術科) Kondo, Kensuke (Faculty of Agriculture, Tottori University) Nakashima, Yasuhiro (Computer Network Engineering, Kumamoto Prefectural College of Technology)		
共同研究要旨 Summary of Joint Research	The purpose of this study is to estimate the possibility of a plant water management of a sand culture system using a capillary watering method. Collecting the data of the amount of water supply to the sand bed (cultivation bed), the transpiration rate of plants grown in the sand bed, and the evaporation rate from the sand bed each day, we analyzed the relationships between these data and weather conditions.		

	<p>1) As the water head difference between water surfaces of the capillary watering system and the sand bed increased, the amount of the soil water content in the sand bed significantly decreased. This result shows that the sand culture system using the capillary watering method can control the amount of the soil water content in the sand bed.</p> <p>2) The evaporation amount from the sand bed and the transpiration rate of tomato plants cv. Micro-Tom planted in the sand bed showed the strong correlation with temperature, soil temperature, and the amount of water evaporation in plant growth chambers. This result indicates that the evaporation rate and the transpiration rate can be predicted on the basis of the weather conditions in the day.</p> <p>3) The relationship between the amount of water supply to tomato plants cv. Micro-Tom and weather conditions of a day in the vinyl house was examined. On fine days, the water supply to tomato plants had a correlation with the amount of water evaporation and that of solar radiation of the day. Then, on cloudy days, the amount of water supply to tomato plants had a correlation with temperature, humidity, and soil temperature of the day. These results show that the necessary amount of water supply to tomato plants can be predicted on the basis of the weather conditions of the day. Considering these findings, this sand culture system using a capillary watering method is usable for the water management and the water control of plants.</p>	
一般研究 18 General Research 18	対応教員 Corresponding Staff	安 萍 An, Ping
研究代表者 Principal Researchers	松浦 朝奈 (東海大学農学部) Matsuura, Asana (School of Agriculture, Tokai University)	
研究課題 Research Subject	中国黄土高原における雑穀の収量性と雑穀の複合環境ストレス耐性機構の解析 Mechanisms of tolerance to combined environmental stress of millets and grain yield of millets in Loess Plateau of China	
研究分担者 Co-researchers	村田 浩平 (東海大学農学部) Murata, Kouhei (School of Agriculture, Tokai University)	
共同研究要旨 Summary of Joint Research	<p>Secondary salinity is often caused by rising watertables in dryland and irrigated fields. This may also coincide with soil sodicity and consequent problems in water infiltration. Saline affected area as secondary salinity is about 76.6 Mha in all of the world and increasing year by year. It is necessary to study of mechanism of combined environmental stress for improving crop yield under such conditions. Millets is minor crop, however, they showed higher water use efficiency than cereals including rice and wheat and so on. It is not clear the mechanism of combined environmental stress of millets. This study was conducted to clear responses to combined salt and hypoxia stress of four millets. <i>Panicum sumatrense</i>, <i>Panicum miliaceum</i>, <i>Echinochloa utilis</i> and <i>Brachiaria ramosa</i> were used. Millets were cultivated with aerated nutrient solution (control), stagnant nutrient solution (hypoxia), aerated nutrient solution including 125 mM NaCl (salinity) and stagnant nutrient solution including 125 mM NaCl (hypoxia and salinity) till harvest.</p>	
一般研究 19 General Research 19	対応教員 Corresponding Staff	恒川 篤史 Tsunekawa, Atsushi
研究代表者 Principal Researchers	村上 健介 (鳥取大学工学部ものづくり教育実践センター) Murakami, Kensuke (Innovation Center for Engineering Education, Tottori University)	
研究課題 Research Subject	乾燥地での観測設備・機器を守るスマートセキュリティシステムの開発 Development of the smart security system protecting the observation equipment and apparatus in an arid land	
研究分担者 Co-researchers	藤巻 晴行 (鳥取大学乾燥地研究センター) 伊藤 健彦 (鳥取大学乾燥地研究センター) Fujimaki, Haruyuki (Arid Land Research Center, Tottori University) Ito, Takehiko (Arid Land Research Center, Tottori University)	
共同研究要旨 Summary of Joint Research	<p>Theft of research equipment that is installed in arid land has often occurred. It had become a factor that inhibits the progress of the study. The security system to protect the facilities and equipment observed is urgently needed, there was no precedent. We have been working on the development of a smart security system reliable and low cost in the arid land for two years.</p> <p>In fiscal 2012, in order to study the invasion of the security system of dry land, we worked to clarify the issues through production and demonstration of prototype.</p> <p>In fiscal 2013, based on this result, and worked on the development of practical machine that takes into account the practical aspects, such as low cost and miniaturization.</p> <p>Monitoring terminal that has been developed is operable placed on the upper surface of the monitored device, only by supplying power. When an abnormality is detected, the captured image is uploaded instantly to the cloud server, mail transmission is at the same time. Viewers can view the recorded images via the Internet. Further, an operable 5 minutes when the power is cut off, the terminal is uploaded to the cloud server captured image during this time.</p>	

The most important feature of this terminal is the realization of a 360° surveillance area using two cameras. The 360° surveillance cameras commercially available, one using a convex mirror is common. Among them, the Ceiling-mounted type is not suitable for this application because of the optical design. On the other hand those that are suitable for this application is also present, but they are expensive and outdoor use is not possible. In this study, with the use of the four infrared sensor for detecting a human body and two low-cost camera capable of operating outdoors, the monitoring system 360° area can be realized at low cost. In the future, we plan to set up a terminal to the field, and measures to tackle the extraction of the challenges through the verification test. We want aims to realize a smart security systems used in the field actually.

一般研究 20 General Research 20	対応教員 Corresponding Staff	恒川 篤史 Tsunekawa, Atsushi
研究代表者 Principal Researchers	田村 憲司 (筑波大学生命環境系) Tamura, Kenji (Faculty of Life and Environmental Sciences, University of Tsukuba)	
研究課題 Research Subject	半乾燥地における形態別抽出法を用いた土壌有機物中のカルシウム複合体の性質 Characterization of soil organic matter associated with calcium isolated by chemical fractionation in semi-arid land	
研究分担者 Co-researchers	神田 隆志 (筑波大学生命環境科学研究科) 小熊 宏一郎 (筑波大学生命環境学群生物資源学類 4 年) Kanda, Takashi (Graduate school of Life and Environmental Sciences, University of Tsukuba) Oguma, Kouichirou (School of Life and Environmental Sciences College of Agro-Biological Resource Sciences 4, University of Tsukuba)	
共同研究要旨 Summary of Joint Research	For our understanding about soil organic carbon dynamics in arid region, we characterized the soil organic matter associated with calcium. Objective of this study was to clarify the quantity and quality of organic carbon extracted by sequential extraction method (water - 0.1 M Na4P2O7) modified from Kaiser and Ellerbrock (2005). Organic carbon fractions extracted by this method were divided into water soluble fraction (OCw), organo-mineral complex fraction extracted by 0.1 M Na4P2O7 (OCpy) and precipitated fraction adjusted to pH=2.0 in 0.1 M Na4P2O7 extracted fraction (OCpy*) using 5 samples. Organic carbon content in each fraction were ranged from 0.13 to 0.23 g/kg (OCw), from 0.86 to 6.17 g/kg (OCpy) and from 0.32 to 3.82 g/kg (OCpy*). From the results of $\Delta\log K-A600/C$ graph, types of OCpy* were A types in all samples. Although OCpy and OCpy* content were increased with increasing total organic carbon content in each samples, OCpy content were 9.3-14.1 % in total organic carbon content. It was necessary to consider about extraction time and extraction rate (solid : liquid). Extracted Ca content were 0.06-0.38 g/kg in OCw and 0.50-1.14 g/kg in OCpy. $\delta^{13}C$ values in each fraction were -21.9 - -23.5 ‰ (OCw) and -23.1 - -26.3 ‰ (OCpy*). Except for 1 sample, $\delta^{13}C$ values in OCpy* were lower than in OCw. To characterization of organic matter associated with calcium, further studies such as composition of organic carbon in each fraction are required.	

一般研究 21 General Research 21	対応教員 Corresponding Staff	恒川 篤史 Tsunekawa, Atsushi
研究代表者 Principal Researchers	西原 英治 (鳥取大学農学部) Nishihara, Eiji (Faculty of Agriculture, Tottori University)	
研究課題 Research Subject	木本類および作物における Hydraulic redistribution の評価 - 干ばつに対応した Intercropping システムでの最適な作物の候補 - Magnitude of Hydraulic redistribution in woody and crop plants -promising candidates for suitable crops in an intercropping system under water stress-	
研究分担者 Co-researchers	柴田 昇平 (近畿中国四国農業研究センター傾斜地園芸研究領域) 星 典宏 (近畿中国四国農業研究センターカンキツブランド化プロジェクト) Shibata, Shouhei (Hillside Horticulture Research Division, NARO Western Region Agricultural Research Center) Hoshi, Norihiro (Profitable Citrus Production Project, NARO Western Region Agricultural Research Center)	
共同研究要旨 Summary of Joint Research	Hydraulic lift (HL) describes the process of vertically passive movement of water from roots into soil occurred at night during dried period with lower water potential, while other parts of plant root system in moister soil layers are absorbing water. While, Hydraulic redistribution (HR) is known as the same process of HL except for the horizontally process. These phenomena are expected to work well in intercropping system of trees and crops because of relaxation effect of dry stress and improving nutrient absorption effect. However, there are no the evaluating method of the strength of HL in several trees. We made certain the environmental condition of the evaluating method last year, so we use the condition and hydrogen stable isotope water (D2O: 0.1%) to make certain occurrence of HL in 6 species of trees and medicinal plant; Melia azedarach, Azadirachta indica, Moringa oleifera, Albizia julibrissin, Tamarix hispida, Eucommia ulmoides and Glycyrrhiza uralensis.	

	As a result, in all plants of soil water contain high concentrate stable isotope, especially Azadirachta indica and Eucommia ulmoides. The value of D2O in blank which is no-plant treatment is -302.67‰, but that of Azadirachta indica and Eucommia ulmoides indicated 807‰ and 586‰ of each. That's means there is some possibility of doing that D2O move to lower layer to upper layer through plants. In addition, the value of D2O in the treatment which prevent occurrence of HL is the same degree to that of blank. Thus, HL occurred in all of seven species of plants and we revealed this experimental system is effective to confirm HL occurrence. In common with Azadirachta indica and Eucommia ulmoides, these consumed few amount of water during treatment, and difference of soil water content between A. indica and E. ulmoides. This tendency also applies to Tamarix hispida which also consumed little water. So, we need to considerate the balance between absorbed, released water and strength of HL. In addition, some plants may re-absorbed Hydraulic lifted water which consume a lot of water despite that these value of D2O are small. Thus, we need to confirm the method to determine the quantity of released and re-absorbed water.
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一般研究 22 General Research 22	対応教員 Corresponding Staff	伊藤 健彦 Ito, Takehiko
研究代表者 Principal Researchers	辻 大和 (京都大学霊長類研究所) Tsuji, Yamato (Primate Research Institute, Kyoto University)	
研究課題 Research Subject	乾燥地および寒冷地に生息する野生霊長類の各種行動形質と生息環境との関連性 Relationships between behavioral traits of wild primates inhabiting dry and cool regions and their habitat environments	
共同研究要旨 Summary of Joint Research	We analyzed regional variation in the dietary regimes of three primate groups (baboons, savanna monkeys and patas monkeys) whose distributions include arid lands, to address feeding strategies enabled them to adapt to harsh environments characterized by relatively low rainfall and high temperature. Three groups in lowland forests fed mainly on fruits and animal matter, whereas populations inhabiting mountainous forests fed more on foliage and other items. There was no clear pattern in feeding behavior in response to latitudinal change. Baboons fed less on sub-terrestrial material at study sites possessing large NDVI, large annual rainfall, and higher temperature. These results implied that primate adaptation to arid land was achieved by behavioral plasticity against harsh environment.	

一般研究 23 General Research 23	対応教員 Corresponding Staff	藤巻 晴行 Fujimaki, Haruyuki
研究代表者 Principal Researchers	斎藤 広隆 (東京農工大学大学院農学研究院) Saito, Hiroataka (Institute of Agriculture, Tokyo University of Agriculture and Technology)	
研究課題 Research Subject	温度勾配下の土中水蒸気移動を利用した節水灌漑に関する研究 Micro-irrigation based upon vapor transport in soils under temperature gradient	
研究分担者 Co-researchers	三宅 光葉 (東京農工大学農学部) Miyake, Mitsuha (Faculty of Agriculture, Tokyo University of Agriculture and Technology)	
共同研究要旨 Summary of Joint Research	Salt affected lands can be found in many arid and/or semi-arid areas because highly saline water is used. When shallow saline groundwater exists, salts often accumulate near the soil surface through capillary rise. To suppress capillary rise of saline groundwater, the concept of capillary barriers has been used by placing a layer with materials having larger pores such as gravels. In this study, the effect of the capillary barrier (CB) on leaf vegetables (Brassica rapa; Kyoto, Japan) was studied at a temperature-controlled phytotron located in FS center of Tokyo University of Agriculture and Technology. A 2-cm coarse sand layer and a 4-cm gravel layer were installed just below a 6-cm surface sand layer where the gravel layer acts as a CB. Three different irrigation schedules were employed. Compared to a control (without a CB) results show that there is no significant effect of CB on growth of leaf vegetables. On the other hand, results also show that irrigating too much water may cause reduction in production due to CB and that vapor transport may be significant through the gravel layer. In this study, a numerical analysis on heat exchange processes between soils and a tube-shape heat exchanger has been conducted to investigate the possibility of controlling soil temperature to enhance vapor transport. A three dimensional conductive heat transport was assumed in soils, while a one dimensional convective-conductive heat transport was assumed for the circulating fluid in the heat exchanger. Such approach has been validated with a large scale thermal response test conducted at TUAT.	

一般研究 24 General Research 24	対応教員 Corresponding Staff	藤巻 晴行 Fujimaki, Haruyuki
研究代表者 Principal Researchers	黒田 清一郎 (農業食品産業総合研究機構農村工学研究所) Kuroda, Seiichiro (National Institute for Rural Engineering, NARO)	



研究課題 Research Subject	乾燥地深層地盤における水分塩分挙動観測技術の開発 Development for monitoring technique of soil water and solute transport in deep vadose zone in arid land area	
共同研究要旨 Summary of Joint Research	<p>Clarification and quantitative estimation of phenomena in the deep vadose zone are essential and necessary in environmental science and engineering. However, it is difficult to clarify these phenomena because of a lack of proper measurement methods. We evaluate the applicability of Ground Penetrating Radar (GPR) for characterization of subsurface structure and groundwater in arid land, which control the transport phenomena of water and solute transport in vadose zone. We conducted the field test in the fields of Arid Land Research Center, Tottori university, using the GPR system with shielded antennas of dominant frequencies, 100, 200, 400, 500, 900, 1.5 GHz. Soil type in the field is almost uniform sand, and water content of soil is around or lower than 5%. Then soil is considered to be lossless media in electric magnetic sense. Penetration depth of each antenna is deeper than values usually reported. For example penetration depth of the system with 100 MHz antennas is considered to be in the range from 20 to 30 m. We visualize 3D subsurface structure using the 100 MHz antenna. The obtained image shows the distribution of ground water table and layer which seems volcanic ash seam in sand and will control water recharge process in vadose zone.</p> <p>We propose a method to monitor soil water and solute dynamics in the vadose zone using cross-borehole GPR. The proposed method can estimate the sequential distribution of water content and solute concentrations over time in a non-destructive way. The advantageous features of this method enable us to clarify solute transport in a deeper zone, where it is difficult to apply conventional methods like probe type sensor. The proposed method can be used to monitor the processes of solute tracer intrusion into deeper subsurface.</p>	
一般研究 25 General Research 25	対応教員 Corresponding Staff	藤巻 晴行 Fujimaki, Haruyuki
研究代表者 Principal Researchers	森井 俊広 (新潟大学農学部) Morii, Toshihiro (Faculty of Agriculture, Niigata University)	
研究課題 Research Subject	土のキャピラリーバリアを利用した根群域の保水性向上と地下水からの塩水侵入阻止に関する研究 Enhancement of Soil Water Retention Capacity in Plant Root Zone and Interception of Upward Saline Water from Groundwater by Using Capillary Barrier of Soil	
共同研究要旨 Summary of Joint Research	<p>A simple soil layer system which is composed of a finer soil layer underlain by a coarser soil layer provides a characteristic property of capillary barrier. Water infiltrated into soil is suspended just above an interface between soil layers due to a physical difference in unsaturated hydraulic properties of soil. As their roots can easily utilize the water retained in the upper soil layer, agricultural plants grow even under water saving irrigation. Because the gravel layer embedded in the soil cuts upward movement of water from groundwater, the capillary barrier of soil is expected to provide an effective prevention of salinization which is caused by salt included in the groundwater. Two series of field experiment were conducted on the sand soil. In the first one, the experiment plots of the capillary barrier soil were constructed, and green vegetables were planted on them. An artificial groundwater, 10,000 ppm of NaCl, was supplied to the experiment plots with a constant head of water. The soil moisture contents and the electric conductivity were measured after planting to harvesting of the plant. In the second series of the experiment, the gravel layer was placed in a circular plate at some depth of the soil, and then the irrigation water was supplied continuously from the soil surface by using the drip irrigation emitter. It is found that the gravel layer embedded in the soil as well as the plate gravel placed at some depth below the soil surface well retains infiltration water above the interface between the sand and gravel. EC measurements showed an excellent interception of upward water movement.</p>	
一般研究 26 General Research 26	対応教員 Corresponding Staff	山中 典和 Yamanaka, Norikazu
研究代表者 Principal Researchers	長田 和雄 (名古屋大学大学院環境学研究所) Osada, Kazuo (Graduate School of Environmental Studies, Nagoya University)	
研究課題 Research Subject	日本における黄砂の沈着量の観測 Observation of mineral dust deposition flux in Japan	
研究分担者 Co-researchers	谷口 武士 (鳥取大学乾燥地研究センター) 黒崎 泰典 (鳥取大学乾燥地研究センター) 篠田 雅人 (鳥取大学乾燥地研究センター) 長島 佳奈 (海洋研究開発機構地球環境変動領域) Taniguchi, Takeshi (Arid Land Research Center, Tottori University) Kurosaki, Yasunori (Arid Land Research Center, Tottori University) Shinoda, Masato (Arid Land Research Center, Tottori University) Nagashima, Kana (Japan Agency for Marine-Earth Science and Technology)	
共同研究要旨 Summary of Joint Research	<p>Weekly wet and dry deposition samples were collected by using a deposition sampler (US 330: Ogasawara Keiki). These samples were analyzed for Fe by XRF at AORI/Univ. of Tokyo. Mineral dust amounts were estimated by applying a conversion factor (Ura et al., 2011). In addition to deposition sampling, we installed</p>	

	<p>a new aerosol monitoring instrument (PM 712: Kimoto Electronics) for PM 10 and PM 2.5. This instrument also serves as a tape sampler for coarse and fine aerosols. Both data and samples are satisfactory collected for this year. None of Kosa dust events was not so large in 2013. However, a weak but discernible Kosa like event was observed in summer based on chemical analysis of tape filter samples at ALRC. This is very rare case and interesting to further investigation.</p> <p>Then, we tried to develop a provenance-tracing method of aeolian dust by using a cathodoluminescence (CL) spectral, focused on its ability to identify defects or impurity (such as Ti<sup>4+</sup>, Ge<sup>4+</sup>, Al<sup>3+</sup>, Fe<sup>3+</sup>) of quartz. We conducted CL spectral analysis of fine silt-sized quartz (&lt;20 μm) in the surface samples taken from Gobi area of southern Mongolia during the field survey of Arid Land Research Center, Tottori University, in July-August, 2012. The CL spectra of fine silt-sized quartz in the samples from Mongolian Gobi tend to exhibit larger peak in blue region at around 3.2 eV (relates to Al<sup>3+</sup> impurity of quartz) compared to the CL spectra of quartz taken from other deserts, such as Taklimakan desert in China. We will further examine the character of CL spectra of quartz in Mongolian Gobi using additional samples.</p>
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一般研究 27 General Research 27	対応教員 Corresponding Staff	山中 典和 Yamanaka, Norikazu
研究代表者 Principal Researchers	館野 隆之輔 (京都大学フィールド科学教育研究センター) Tateno, Ryunosuke (Field Science Research and Education Center, Kyoto University)	
研究課題 Research Subject	中国黄土高原におけるニセアカシアとリョウトウナラ林における水利用効率の長期変動 Long term changes in water use efficiency of <i>Quercus liaotungensis</i> and <i>Robinia pseudoacacia</i> on Loess Plateau, China	
研究分担者 Co-researchers	杜 盛 (中国科学院水土保持研究所) Du, Sheng (Institute of Soil and Water Conservation, Chinese Academy of Sciences)	
共同研究要旨 Summary of Joint Research	<p>In forest near arid boundary, tree growth is significantly affected by precipitation. Under water limitation, water use efficiency of trees tends to be increased. Carbon stable isotope ratio in plant tissue has been used as an index of water use efficiency of plants. In this study we investigated long term changes in water use efficiency of major tree species, <i>Quercus liaotungensis</i> and <i>Robinia pseudoacacia</i> on Loess plateau, China. Furthermore we compared carbon isotope ratio between living leaves and dead leaves collected same year for methodological consideration, because many studies have used living leaves for investigating for water use efficiency.</p> <p>The study was conducted in the forest on Mt. Gonglu near Yan-an City, on Loess plateau, China. We have collected litterfall in two types of forest, i.e. indigenous natural oak forest (<i>Q. liaotungensis</i>) and imported black locust plantation (<i>R. pseudoacacia</i>). Collected litterfall were separate into species and organs, and ground using mill for preparation of stable isotope ratio.</p> <p>Average of carbon isotope ratio of <i>Q. liaotungensis</i> and <i>R. pseudoacacia</i> leaf litters for six years (2004–2009) was -26.8‰ ranged from -25.6 to -27.6‰ and -25.2‰ ranged from -24.8 to -25.4‰, respectively. Variations among years were small for both species. In contrast, leaf litter productions were widely changed among years for both species. These results may suggest that these two dominate species adjust to annual variation in precipitation by leaf production rather than water use efficiency at leaf level.</p> <p>According to comparison between living leaves and dead leaves of <i>Q. liaotungensis</i>, there were small differences in carbon isotope ratio, suggesting evaluation of water use efficiency using leaf litter is effective method.</p>	

一般研究 28 General Research 28	対応教員 Corresponding Staff	山中 典和 Yamanaka, Norikazu
研究代表者 Principal Researchers	板井 章浩 (鳥取大学農学部) Itai, Akihiro (Faculty of Agriculture, Tottori University)	
研究課題 Research Subject	ナシの乾燥ストレス応答における適合溶質の役割 The role of compatible solutes in response to drought stress in <i>Pyrus</i>	
共同研究要旨 Summary of Joint Research	<p><i>P. betulaefolia</i> seedlings grew well without toxic symptoms less than 100 mM NaCl treatment. But, 200 mM NaCl treatment resulted in dark-brownish leaf burn at the base of seedlings one week after initiation of the NaCl treatment. Photosynthetic rate started to decline one day after initiating the NaCl treatments. <i>P. betulaefolia</i> seedlings showed quick response to higher salinity stress. For chlorophyll fluorescence measurements, Fv/Fm value also declined one day after 200 mM NaCl treatment. Sorbitol content was very high and was thought to be involved in the accumulation of compatible solutes. To classify the role of sorbitol against the salinity stress within <i>Pyrus</i> species, expressed sequence tag (EST) analysis was done with various tissues of <i>Pyrus</i>. Nine putative genes encoding sorbitol dehydrogenase, one gene encoding sorbitol-6-phosphate dehydrogenase, and five genes encoding sorbitol transporter were cloned. Of these genes, SOT2-1 and SOT4-1 encoding sorbitol transporter showed up-regulated by saline treatment. Sorbitol plays an important role against salinity stress in <i>Pyrus</i>.</p>	

一般研究 29 General Research 29		対応教員 Corresponding Staff	山中 典和 Yamanaka, Norikazu
研究代表者 Principal Researchers	松尾 奈緒子 (三重大学大学院生物資源学研究科) Matsuo, Naoko (Graduate School of Bioresources, Mie University)		
研究課題 Research Subject	安定同位体比を用いた土壌塩類集積地における塩生植物と土壌間の窒素循環の解明 Nitrogen cycle between halophytes and soil in a salt-accumulated desert determined by stable isotope analysis		
研究分担者 Co-researchers	齋木 拓郎 (三重大学生物資源学研究科) 青木 万実 (三重大学生物資源学研究科) 尾坂 兼一 (滋賀県立大学環境科学部) Saiki, Takuro (Graduate School of Bioresources, Mie University) Aoki, Mami (Graduate School of Bioresources, Mie University) Osaka, Kenichi (School of Environmental Science, The University of Shiga Prefecture)		
共同研究要旨 Summary of Joint Research	<p>We examined the nitrogen (N) cycle in the per-arid, hyper-saline, and N-limited ecosystem in Central Asia by stable isotope analysis. The nitrogen isotope ratios of leaf organic matter and soil N were measured for five native species in the four experimental plots with different salinity-levels near the Aidin Lake, Xinjiang, China. The total N amount in the soil was lower in the high-salinity plot, suggesting that the rates of N production and N turnover were lower in the hyper-saline environments. The nitrogen isotope ratio of total N in the soil was also lower in the high-salinity plot. The rate of ammonia volatilization is high in alkaline conditions, which results in 15N enrichment in ammonium in the soil. Therefore, the lower isotope ratio of soil N in the high-salinity plot was attributed to lower dependency of the plants on the recycled N that was more enriched in 15N. <i>Tamarix hispida</i> had smaller differences in the nitrogen isotope ratio between leaf organic matter and soil N than other four species, suggesting that the four species depended mainly on 15N-enriched ammonium and <i>T. hispida</i> depended on both 15N-depleted nitrate and 15N-enriched ammonium.</p>		
一般研究 30 General Research 30		対応教員 Corresponding Staff	山中 典和 Yamanaka, Norikazu
研究代表者 Principal Researchers	谷口 真吾 (琉球大学農学部亜熱帯農林環境科学科) Taniguchi, Shingo (Faculty of Agriculture, University of the Ryukyus)		
研究課題 Research Subject	マングローブ植物における耐塩機構 Salt tolerance mechanism in mangrove plants		
研究分担者 Co-researchers	吉元 充 (琉球大学農学部) 野口 安佳里 (琉球大学農学部) Yoshimoto, Mitsuru (Faculty of Agriculture, University of the Ryukyus) Noguchi, Akari (Faculty of Agriculture, University of the Ryukyus)		
共同研究要旨 Summary of Joint Research	<p>For our research this year we applied salt stress to <i>Kandelia obovata</i> and <i>Avicennia marina</i>, which were acclimatized to freshwater, investigating the storage mechanism of the osmolyte betaine while simultaneously carrying out gas exchange measurements of the photosynthetic rate in the leaves and the like, and studying the relationship of physiological response to salt with osmolytes. For the material under test, year-old seedlings of <i>Avicennia marina</i> and <i>Kandelia obovata</i> were used. Three seedlings were cultivated in soil in 1/5000 a Wagner Pots. We prepared a total of 3 test groups of 6% and 3% salt concentrations with control pots of 0% salt concentrations and over a 24 hour period flooded one test plot per each 10 pots of each tree species. Using a LI-6400 Portable Photosynthesis System, the gas exchange characteristics of the leaves were measured 4 hours, 8 hours and 2 days following flooding-digging up the specimens 15 days following flooding. After the specimens were freeze-dried, we used capillary electrophoresis equipment to make a betaine analysis.</p> <p>The results were that the stress caused by salt could be seen in the gas exchange characteristics of the leaves in the <i>Avicennia marina</i>-observing a high accumulation of betaine in the whole of the treated plots. Of the detectable betaine, there was a high concentration of glycine betaine in the <i>Avicennia marina</i>. The amount of betaine in the <i>Kandelia obovata</i> was negligible, inferring that other factors are involved in regards to osmotic regulation. From the organ-specific betaine concentrations in the <i>Avicennia marina</i>, we established that the flowers, leaves, branches, taproot, spongeroots, and rootlets in this order had the largest concentrations of glycine betaine, confirming that the osmotic pressure on the top portion of the plant body was indeed being raised.</p>		
一般研究 31 General Research 31		対応教員 Corresponding Staff	山中 典和 Yamanaka, Norikazu
研究代表者 Principal Researchers	山本 福壽 (鳥取大学農学部) Yamamoto, Fukuju (Faculty of Agriculture, Tottori University)		

研究課題 Research Subject	中国乾燥地の移動砂丘固定に用いられる小葉楊 ( <i>Populus simonii</i> ) の乾燥地適応と繁殖戦略、および植栽技術開発に関する研究 Studies on stress adaptability, reproductive strategy and reforestation technology of <i>Populus simonii</i> for sand dune fixation in Kubuchi desert, China
共同研究要旨 Summary of Joint Research	To evaluate the effect of sand burial on water use and growth of <i>Populus simonii</i> trees in Kubuqi desert, Inner Mongolia, China, we compared physiological characteristics of this species on a slope of a sand hill (sand burial site) and on flat plane at the base of the hill (reference site) in growing season of 2012. Although sap flux density and its response to water vapor deficit were similar between the sites, leaf scale measurement of stomatal conductance and transpiration were lower in the sand burial site than the flat site. Whole-tree sap flow was larger in the sand burial site due to larger tree size. Effects of sand burial on growth, osmotic adjustment and Fv/Fm ratio and $\delta^{13}C$ in leaves were investigated in <i>P. simonii</i> saplings in Kubuqi desert in August, 2013. Tree heights and annual ring widths in the saplings were rapidly increased as the increase in the depth of sand burial. In leaves of sand-buried saplings on dune slopes high amounts of accumulated osmolytes including mannitol, a sugar alcohol, and three kinds of betaines as $\beta$ -alanine betaine, glycine betaine and $\gamma$ -butylobetaine were detected, suggesting water stress environment on the dune slopes. These results indicate that sand burial enhances growth and development of <i>P. simonii</i> saplings planted in sand-moving deserts. Effects of artificial sand burial on growth of <i>P. simonii</i> , <i>P. alba</i> and <i>Salix matsudana</i> cuttings planted and buried at 0%, 50%, and 100% of plant heights with sand were investigated in the dune field of Arid Land Research Center, Tottori University. The 100% sand burial significantly increased height growth and adventitious root formation on buried stems of <i>P. simonii</i> cuttings of all species. Ethylene production from stem segments of buried cuttings was greatly enhanced at 7 days after the initiation of sand burial.

一般研究 32 General Research 32	対応教員 Corresponding Staff	谷口 武士 Taniguchi, Takeshi
研究代表者 Principal Researchers	山中 高史 (森林総合研究所森林微生物研究領域) Yamanaka, Takashi (Forest Microbiology Division, FFPRI)	
研究課題 Research Subject	菌根菌ネットワークによる塩類ストレス下における樹木間養分転送機構の解明 Mechanisms of nutrient transfer among trees via mycorrhizal network under high salinity conditions	
研究分担者 Co-researchers	竹内 祐子 (京都大学農学研究科) Takeuchi, Yuko (Graduate School of Agriculture, Kyoto University)	
共同研究要旨 Summary of Joint Research	To clarify the mechanisms of nitrogen transfer between trees via their associated ectomycorrhizal (EM) fungi, we planted seedlings of alder and pine together in cylindrical containers with separating their root systems in bags made by nylon mesh. After eight month cultivation, roots of both tree were developed into the outside of the bag which is 150 $\mu$ m in mesh size, however roots in the bag of 50 $\mu$ m nylon mesh remained within the bag. The EM formation on root of alder and pine was few; however, differences of EM formation between two tree species were observed. Root nodules did not develop in alder, nor the same morphotype of EM were not observed in both trees; therefore the transfer of N fixed symbiotically by alder to pine was not expected. However $\delta^{15}N$ in the pine cultivated with alder was lower than that cultivated alone. The results showed that $\delta^{15}N$ in pine could be an indicator for evaluating the function of alder in N acquisition of pine.	

一般研究 33 General Research 33	対応教員 Corresponding Staff	篠田 雅人 Shinoda, Masato
研究代表者 Principal Researchers	佐藤 源之 (東北大学東北アジア研究センター) Sato, Motoyuki (Center for Northeast Asian Studies, Tohoku University)	
研究課題 Research Subject	地中レーダ(GPR)による乾燥地の土壌水分計測 Soil Moisture measurement by Ground Penetrating Radar in Dry area	
研究分担者 Co-researchers	黒田 清一郎 (農村工学研究所基礎地盤研究室) 高橋 一徳 (東北大学東北アジア研究センター) Kuroda, Seiitiro (National Institute of Rural Engineering) Takahashi, Kazunori (Center for Northeast Asian Studies, Tohoku University)	
共同研究要旨 Summary of Joint Research	We have conducted Ground Penetrating Radar (GPR) experiment at the Tottori University Arid Land Research Center on February 26, 2014. This is a test measurement for actual Arid Land measurement in Mongolia which we plan for the next year. This measurement will be synchronized with the Japanese Earth Observation Satellite (ALOS-2) which will be launched in May 2014. The weather conditions were dry with air temperature ranging from 12 and 14 $^{\circ}$ C. Two RAMAC 500 MHz (Måla Geoscience) antennas were used for the common mid-point (CMP) measurements. Near-surface soil water content was measured by TRIME	

	PICO 64 (IMKO) TDR probe. Groundwater tables were measured different gauges installed at the Arid Land Center. CMP is used for the estimation of vertical profile of water content. In addition to CMP. We have conducted common-offset GPR measurement for larger area survey. We think CMP gives precise estimation in selected pints, and common offset survey can expand the area of survey effectively. We selected 2 sites in the field, where one has a water level deeper than 20 m, while the other has in several meters. We could clearly image the laminated layer of sand in the deep ground water site, and the ground water table was clearly detected in the shallower ground water level region. We think this is a good result and we think we can apply the same approach in Mongolia next year.
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一般研究 34 General Research 34	対応教員 Corresponding Staff	篠田 雅人 Shinoda, Masato
研究代表者 Principal Researchers	鹿島 薫 (九州大学理学研究院) Kashima, Kaoru (Faculty of Sciences, Kyushu University)	
研究課題 Research Subject	地形および土壌環境解析を用いたモンゴル・ゴビ砂漠における風成塵 (黄砂) の長期的変動の復元 The long-term fluctuation of aeolian dusts (KOSA) at Gobi Desert in Mongolia presumed by geomorphology and soil environmental analyses	
研究分担者 Co-researchers	安福 規之 (九州大学工学研究院) 福本 侑 (九州大学理学研究院) ガンゾリック ウルギイチメック (モンゴル科学院地理学研究所) Yasufuku, Noriyuki (Faculty of Engineering, Kyushu University) Fukumoto, Yu (Faculty of Sciences, Kyushu University) Ganzorig Ulgiichimeg (Institute of Geography, Mongolian Academy of Sciences)	
共同研究要旨 Summary of Joint Research	In 2013, we visited to Mongolia from August 24 through September 5. We took the investigations for the soil distributions Tsokuto-Oboo and Bayan Unjur where the field monitoring equipments were set at Gobi desert with the Geographical Institute of Mongolian Academy of Sciences. In addition to it, we started a preliminary survey to reconstruct paleo-environmental changes at Lake Uulan, west of Tsokuto-Oboo. Based on these field data, we discussed about the long-term fluctuation of aerial dusts at Gobi Desert, and presumed distribution of fine materials those were derived by ancient river flows of the geologic period. The results of the surveys were reported at the annually meeting of the institute on December 2013.	

一般研究 35 General Research 35	対応教員 Corresponding Staff	篠田 雅人 Shinoda, Masato
研究代表者 Principal Researchers	島田 章則 (麻布大学生命環境科学部) Shimada, Akinori (School of Life and Environmental Science, Azabu University)	
研究課題 Research Subject	モンゴルの家畜で発生している <i>Oxytropis glabra</i> 植物中毒の発生機序 Pathogenesis of the plant poisoning by <i>Oxytropis glabra</i> in Mongolian livestock animals	
共同研究要旨 Summary of Joint Research	In recent years, neurological disorder developed in livestock animals that grazed toxic plant, <i>Oxytropis glabra</i> in Mongolia. Affected goats show vacuolar degeneration and loss of Purkinje cells in the cerebellum. Chemical analysis of <i>O. glabra</i> detected swainsonine (61.8 µg/g) in the plant. The purpose of this study was to elucidate the mechanism of vacuolar changes in mice (in vivo) and in the cultured bovine renal epithelial cells treated with swainsonine. Both light microscopy and electron microscopy showed vacuolar changes in the renal epithelial cells (in vivo, in vitro). These vacuoles were identical to the vacuoles observed in Purkinje cells of the affected goats. Autophagy disorder resulting from inhibition of lysosomal enzyme may be involved in the process of vacuolar changes in the affected cells.	

一般研究 36 General Research 36	対応教員 Corresponding Staff	木村 玲二 Kimura, Reiji
研究代表者 Principal Researchers	高山 成 (大阪工業大学工学部環境工学科) Takayama, Naru (Faculty of Engineering Dept. of Environmental Engineering, Osaka Institute of Technology)	
研究課題 Research Subject	鳥取砂丘の草原化に対する景観保全活動による砂移動の回復状況のモニタリング Monitoring of sand-move remediation with activity of landscape conservation for anti-glass-land in Tottori sand dune	
研究分担者 Co-researchers	紫竹 大貴 (大阪工業大学工学部) Shitiku, Daiki (Faculty of Engineering, Osaka Institute of Technology)	
共同研究要旨 Summary of Joint Research	In this study, we aimed to clarify actual sand-moving of the natural monument "Tottori sand dune" from 2001 to 2011. Digital Elevation Model (DEM) with 10-meter mesh was created based on the new land survey data in 2006 and 2011. We analyzed a quantity of sand-move after from 2001 to map a tendency of erosion or deposition. Also, each 10-meter mesh was classified by topography like a ridge or valley. We investi-	

	gated a sand-move association with topography. The average elevation of Tottori sand dune was 35.12 m and 35.16 m in 2006 and 2011, respectively. These were same level as 35.17 m of 1964. We extracted the areas of big and small of sand-dune, valley, bottom and top by using the topographical classification methods in 2001, 2006 and 2011, and analyzed association with quantity of sand-move. As a result, the numbers of mesh which was classified in "bottom" or "top" have extended around No. 2 sand dune area in 2011. It indicates that rehabilitation of topographical characteristic of sand dune like bottom (the suribati) and sand-dune. The ratio of each topography mesh which include in erosion or deposition area was analyzed. It could not obtained correlations in the relationship between a topography and the tendency of sand-move.	
一般研究 37 General Research 37	対応教員 Corresponding Staff	安田 裕 Yasuda, Hiroshi
研究代表者 Principal Researchers	清水 克之 (鳥取大学農学部) Shimizu, Katsuyuki (Faculty of Agriculture, Tottori University)	
研究課題 Research Subject	砂地砂漠オアシスにおける湧水の涵養機構について On recharge mechanism of spring at oasis in sand desert	
研究分担者 Co-researchers	斎藤 忠臣 (鳥取大学農学部) 磯本 英孝 (鳥取大学農学部) Saito, Tadaomi (Faculty of Agriculture, Tottori University) Isomoto, Hidetaka (Faculty of Agriculture, Tottori University)	
共同研究要旨 Summary of Joint Research	<p>Temporal and spatial distribution of groundwater level (GWL) and responses of groundwater (GW) and discharge of spring to rainfall are analyzed based on hydrological observations at Suijin Spring and its basin in Arid Land Research Center.</p> <p>Obtained results are summarized as follows;</p> <p>(1) GWL was almost stable or slightly rose from February to April due to recharge by snowmelt water. After that, GWL gradually dropped until late July and then, rised according to several rainfall events.</p> <p>(2) Spring discharge increased in March and April, and then gradually decreased until late July. It repeated increase and decrease in August and September, and then gradually increased.</p> <p>(3) Observation wells are classified into 4 groups based on the fluctuation patterns such as group (a) shallow GW depth (0~5 m) with quick response to rainfall, (b) deeper GW depth (5~10 m) with slower response to rainfall than group (a), (c) deep GW depth (deeper than 20 m) with very slow response to rainfall, and (d) GW depth is about 11 m. Though GWL is higher than groups (b) and (c), it does not change except in August.</p> <p>(4) Existence of a purched water table is suggested in upper part of the observed spring basin.</p> <p>(5) Seasonal change of GW flow direction was observed.</p> <p>(6) From the result of spring flux at different depths, it is suggested that complicated soil layers influence increase and decrease of spring discharge.</p> <p>In order to clarify the mechanism of recharge process in the spring, a water balance analysis should be done with considerations of the influence of impeameable layer on GW recharge and refining of the recharge area for next step.</p>	
一般研究 38 General Research 38	対応教員 Corresponding Staff	安田 裕 Yasuda, Hiroshi
研究代表者 Principal Researchers	中川 啓 (長崎大学水産・環境科学総合研究科) Nakagawa, Kei (Graduate School of Fisheries Science and Environmental Studies, Nagasaki University)	
研究課題 Research Subject	乾燥地における土壌中の反応輸送モデルの開発 Reactive transport modeling of subsurface flow in arid environment	
研究分担者 Co-researchers	細川 土佐男 (九州産業大学工学部) 長浦 善之 (長崎大学環境科学部) Hosokawa, Tosao (Faculty of Engineering, Kyushu Sangyo University) Nagaura, Yoshiyuki (Faculty of Environmental Studies, Nagasaki University)	
共同研究要旨 Summary of Joint Research	<p>One of the most important problem in arid environment is salt accumulation in soil. The numerical simulation is useful to evaluate the remediation method. It is also useful to reproduce the mechanism of salt accumulation. In this study as a first step to develop better tool for simulating reactive transport in the soil, we made reconsideration of our developed model and anew lab-experiment was performed to obtain parameters used in the simulation. Then, we simulated the past lab-experiment that was mimicked salt-groundwater uptake by the transpiration in the soil column. According to the vertical distribution after 3 days, Ca and Mg ions showed concentration peak at the specific depth in liquid phase. Because both of adsorbed components showed depressions at the lower part than the peaks in the liquid phase, the peaks seem to be formed by the desorbed components. Because high Na component included in the salt-groundwater, Na ion exchanged with</p>	

	Ca and Mg ions and then, Na ion adsorbed on the solid phase in the lower part of the soil column. Cl ion distribution corresponded to the rising height of water from the bottom. We now started to obtain data of column experiment under arid condition in the climate chamber. The data will be used for verification of our developed model.
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一般研究 39 General Research 39	対応教員 Corresponding Staff	安田 裕 Yasuda, Hiroshi
研究代表者 Principal Researchers	依田 清胤 (石巻専修大学理工学部基礎理学科) Toda, Kiyotusgu (Faculty of Science and Engineering, Ishinomaki Senshu University)	
研究課題 Research Subject	外来侵略性樹種メスキートの種子膨潤過程における乾燥耐性の評価 Evaluation of tolerance to drought in imbibing seeds of Mesquite, an invasive alien species.	
研究分担者 Co-researchers	辻 渉 (鳥取大学農学部) 齋藤 忠臣 (鳥取大学農学部) 井上 知恵 (鳥取大学乾燥地研究センター) Tsuji, Wataru (Faculty of Agriculture, Tottori University) Saito, Tadaomi (Faculty of Agriculture, Tottori University) Inoue, Tomoe (Arid Land Research Center, Tottori University)	
共同研究要旨 Summary of Joint Research	<p>Mesquite (<i>Prosopis juliflora</i> (Swartz) DC) is highly drought-tolerant, invasive tree species in dry and semi-dry regions in the world. Properties of invasion and establishment of seedling population, especially seed germination, should be investigated and clarified to improve the management plan of the expansion of mesquite population. Mesquite seed is known to be enlarged in size during imbibition, and its internal (endospermic) structure changed to mucilage-like feature. The purpose of this study is to clarify ecological and/or physiological characteristics of mucilage-like endospermic structure of imbibing seed. We investigated germination processes of mesquite seeds under different osmotic pressure conditions using PEG, and analyzed the variation of internal structure of imbibing seeds using Environmental Scanning Electron Microscope (ESEM).</p> <p>Results of germination experiments were: 1) seeds germinated even under -1.5~-1.9 MPa of osmotic pressures, which were lower than the wilting point of usual plants, 2) removal of endospermic structure strongly suppressed germination rate, 3) endospermic structure alleviated the reduction of germination rate after the re-desiccation treatment of imbibed seeds. Anatomical observations clarified that internal structure of imbibing seeds consisted of 4) two layers of heteromorphic cells, in addition to cuticle, epidermis containing light line and palisade cells, and 5) these heteromorphic cells deformed to gel-like features within less than one hour after water-adding treatment. These results indicated that endospermic structure contributes to maintain higher percentages of germination rate, and suggest that this internal structure has some ecological and/or physiological role for drought-tolerance of mesquite seeds.</p>	

一般研究 40 General Research 40	対応教員 Corresponding Staff	安田 裕 Yasuda, Hiroshi
研究代表者 Principal Researchers	登尾 浩助 (明治大学農学部) Noborio, Kosuke (School of Agriculture, Meiji University)	
研究課題 Research Subject	砂丘畑から発生する温室効果ガスのモデル化 Modeling greenhouse gas emissions from a dune sand field	
研究分担者 Co-researchers	藤巻 晴行 (鳥取大学乾燥地研究センター) 徳本 家康 (鳥取大学乾燥地研究センター) Fujimaki, Haruyuki (Arid Land Research Center, Tottori University) Tokumoto, Ieyasu (Arid Land Research Center, Tottori University)	
共同研究要旨 Summary of Joint Research	<p>The objective of this study is to measure greenhouse gas (GHG) emissions from corn fields with the chamber method when the irrigation system is applied to best management practices for corn product. The experiment sites were 12 m by 30 m plots for each drip irrigation systems at the Arid land research center (35°32'N, 134°13'E), Tottori University, Japan. The soil was a siliceous sand with a shallow groundwater level down to 9 m below soil surface. We measured carbon dioxide, nitrous oxide, and methane fluxes using a closed chamber and analyzed the data using gas chromatography. Soil moisture and evapotranspiration were obtained by time domain reflectometry and a weighing lysimeter, respectively. Drainage from the bottom of the lysimeter allowed us to estimate seasonal change in groundwater recharge. Green house gas fluxes from the sandy field were considerably small, but we observed high loss of nitrate (&gt; 10 ppm), suggesting that indirect emission of GHG may occur through groundwater. With the DNDC model, we estimated GHG emission from the sandy field. However, soil water retention model of the DNDC model did not perform adequately to calculate water flow for sand. It requires for a better water retention model such as van Genuchten to predict GHG fluxes more accurately.</p>	

一般研究 41 General Research 41		対応教員 Corresponding Staff	安田 裕 Yasuda, Hiroshi
研究代表者 Principal Researchers	縄田 浩志 (秋田大学国際資源学部) Nawata, Hiroshi (Faculty of International Resource Sciences, Akita University)		
研究課題 Research Subject	スーダン東部半乾燥地における降水量の経年季節変動に対応した天水農耕システムの研究 A Study of Rain-Fed Agriculture System Adapting to Seasonal Variation and Periodical Change of Precipitation in Semi-Arid Eastern Sudan		
共同研究要旨 Summary of Joint Research	<p>The purpose of this study is to analyze rain-fed agriculture systems, as survival strategies of local peoples, adapting to seasonal variation and periodical change of precipitation in semi-arid Eastern Sudan.</p> <p>We published three articles and six book chapters this year. We could start field researches together, by obtaining a fund, Grants-in-Aid for Scientific Research, Scientific Research (A) "A Study of Integrated Management Plans of An Alien Invasive Species Mesquite in Arid Lands of West Asia and Africa" (Principal Investigator: Hiroshi Nawata).</p>		
一般研究 42 General Research 42		対応教員 Corresponding Staff	安田 裕 Yasuda, Hiroshi
研究代表者 Principal Researchers	西山 浩司 (九州大学工学研究院) Nishiyama, Koji (Faculty of Engineering, Kyushu University)		
研究課題 Research Subject	大気中水蒸気量による雨季開始時期予測手法の開発—ナイル川中流域天水農業地帯を対象として— Development of prediction model on onset of the rainy period using atmospheric moisture -In rain-fed agricultural region of the Nile middle stream-		
共同研究要旨 Summary of Joint Research	<p>The final goal of this study is to estimate the onset of a rainy season in Sudan for effectively supporting Sudan agricultural activities. For approaching the goal, it is necessary to understand long-term climate features in Sudan.</p> <p>Therefore, the purpose of this study in the first year is to investigate significant relationships between climate change and daily rainfall in Sudan using Self-Organizing Map, which is one of unsupervised artificial neural networks and has an ability to help visual understanding of patterns consisting of non-linear complicated variables. In Sudan, the northward shift of Inter-Tropical Convergence Zone causes much of annual rainfall between June and September every year. Therefore, daily variation of ITCZ was represented by spatial distributions of precipitable water (vertically-accumulated water vapor amount) and wind components at 850 hPa obtained by daily NCEP reanalysis, which shows gridded database of 2.5 degrees (longitude, latitude). Target area consists of 42 grid points (longitude: 7 points, latitude: 6 points), covering all areas of Sudan (the northern region of old Sudan). Target period is 52 years from 1960 to 2011. The number of total samples is 18992 because daily meteorological field was used. Based on the procedure, meteorological fields for 52 years were classified into 900 patterns.</p> <p>The results show that Sudan rainfall for 52 years depends highly on meteorological field patterns representing the most northward shift of ITCZ towards northern arid-region of Sudan. The rainfall amount caused by these patterns is equivalent to approximately 30% of total rainfall at Khartoum in Sudan. It was found that, actually, drastic decreasing in the number of occurrence of these patterns in Sudan since 1970 is highly related to decreasing trend of Khartoum rainfall including severe droughts.</p>		
一般研究 43 General Research 43		対応教員 Corresponding Staff	安田 裕 Yasuda, Hiroshi
研究代表者 Principal Researchers	チャクラバルティ アビック (鳥根県中山間地域研究センター) Chakraborty, Abhik (Mountainous Region Research Center, Shimane)		
研究課題 Research Subject	乾燥地の河川流域における住民の幸福度と気象・水文・植物生態変動の関係：アフリカナイル川流域の事例 Exploring the Relationship between Happiness Coefficient and Climate Change, Vegetation Cover Change of Arid Zone Basin Societies: Case Study of the Nile River Basin in Africa		
研究分担者 Co-researchers	鍋田 肇 (鳥取大学乾燥地研究センター) Nabeta, Hajime (Arid Land Research Center, Tottori University)		
共同研究要旨 Summary of Joint Research	<p>The Nile and Recent Changes in its Basin Environment: Evidences from Literature Introduction: Characteristics of the Nile</p> <p>This fiscal year, the Nile and recent changes in its Basin environment were analyzed from literature and census data survey, focusing environment and development.</p> <p>The aim of this analysis was to provide a summary of the many problems that plague the Nile Delta today and the complex interrelationship they share. At this stage, we tentatively put forth the proposal of 'resource sharing' (following Wonddwoossen). However, this would not be possible without a comprehensive knowl-</p>		



	<p>edge base of how the interlinkages in the system work, and what spatial and temporal effects appear on the system. However, the sound ecological, economical, political and equitable utilization of the fragile Nile basin resources is a difficult task. This is primarily because the asymmetries of the Nile basin are manifold (Allan, 2009). The environmental history of the Nile basin tells us that the first half of the Holocene was wetter than today and drier conditions came from about 500 BP. Sediment records from Lake Albert and Nile delta reveals severe droughts 4200 years BP and great deforestation in the Ethiopian highlands. This change in climatic shift has also changed (increased) land degradation in the more fragile Nile system, and the change is exacerbated by the ongoing spread of agriculture and industrialization. The Nile environment is closely related to the ENSO effects as well. Years of low flow prevails when SOI is strongly negative. As more than 300 million people will depend upon the Nile for their livelihoods by 2020, it is very important that we understand the land use and its changes with reference to with the overall environmental history of the Nile Basin (Williams, 2009) and plot future consequences by taking the broader spatial and temporal scales. It is in this sense that it is important to consider ecological demand of water in the Nile basin and with an integrative discourse that is not based solely on the budgetary provision of water. The need is to incorporate ecosystem flows in the basin into any future plan of development by taking into account the fullest possible range of political-economic and ecological connotations. A part of research achievement has been submitted to a publication of 'Rivers and Human Societies' as "Vegetation Change and Impact on Local Society due to Fluctuation in Rainfall in the Midstream of the Nile River."</p> <p>Acknowledgement</p> <p>I am deeply indebted to Dr. Hiroshi Yasuda of the Arid Land Research Center at Tottori University for providing a part of the research materials and Dr. Shamik Chakraborty (Independent Researcher) for his invaluable inputs in completing this paper.</p>
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一般研究 44 General Research 44	対応教員 Corresponding Staff	安田 裕 Yasuda, Hiroshi
研究代表者 Principal Researchers	矢吹 哲夫 (酪農学園大学環境共生学類) Yabuki, Tetsuo (Department of Environmental and Symbiotic Science, Rakuno Gakuen University)	
研究課題 Research Subject	乾燥地の侵入植生の拡散について=レジームシフトの可能性の理論的解析= A study on expansion of invading plants into dry land =Theoretical analysis of regime shift=	
研究分担者 Co-researchers	星野 仏方 (酪農学園大学環境共生学類) Hoshino, Buho (Department of Environmental and Symbiotic Science, Rakuno Gakuen University)	
共同研究要旨 Summary of Joint Research	<p>A significance of regime shift from one stable phase to another phase has been concerned in various fields of ecology and environmental sciences, especially in lake and savannah ecosystems. When a change in a system satisfies the following three conditions (according to a criteria given by T. Yabuki), it is called a regime shift. (1) A great change in a system such as ecosystem happens suddenly. (2) The changes in environmental conditions progress not suddenly but slowly. (3) There is a hysteresis in the sense that a threshold value for a recovering process is more severe than that for an original changing process.</p> <p>In alpine ecosystem warm temperature in spring should accelerate the snowmelt, which shortens the duration of snowmelt water supply. As a result, soil moisture conditions might be insufficient for the growth of alpine plants inhabiting moist habitat, and lead to an invasion of dwarf bamboo that had inhabited drier habitat with smaller snow accumulation. The high transpiration ability of dwarf bamboo, because of evergreen leaf habit and huge aboveground biomass, may accelerate the decrease in soil moisture and promote this situation as a feedback system.</p> <p>Using a dynamic mean field model formulated by T. Yabuki, the regime shift of vegetation change in alpine ecosystem owing to climate change has been theoretically analyzed.</p> <p>In this talk, T. Yabuki reported the present product of our theoretical analysis, containing the novel and original parametric analysis, developed in the latest our study based on the new field experimental result obtained by G. Kudo in which we have found alpine plant lost once has recovered after cutting down dwarf bamboo. We proposed the two possible scenarios explaining this fact. First possible scenario is that a stable phase for alpine plants had not yet disappeared even after dwarf bamboo took the place of them. Second scenario is that a stable phase for alpine plants had already disappeared after then, and its stable phase has recovered after cutting down dwarf bamboo thanks to the increase of soil moisture as the initial condition of water dynamics.</p> <p>We also proposed that our model analysis might be much valid for studying the vegetation dynamics in various arid areas especially in northern chilly arid areas.</p>	

一般研究 45 General Research 45	対応教員 Corresponding Staff	黒崎 泰典 Kurosaki, Yasunori
研究代表者 Principal Researchers	杉山 晶彦 (鳥取大学農学部) Sugiyama, Akihiko ( Faculty of Agriculture, Tottori University)	

研究課題 Research Subject	鳥取県に飛来する黄砂エアロゾルに含有される有害金属による健康リスクに関する研究 Research of health risk of poisonous metal of yellow dusts aerosol in Tottori
研究分担者 Co-researchers	大西 一成 (鳥取大学医学部) Onishi, Kazunari (Faculty of Medicine, Tottori university)
共同研究要旨 Summary of Joint Research	<p>In the present study, the effect of prenatal arsenic exposure on brain of fetuses and infants in rats was examined histopathologically.</p> <p>[1] Pregnant rats were treated intraperitoneally with 10, 20, 30 mg/kg of NaAsO<sub>2</sub> on gestation day 13, and fetal brains were examined histopathologically 24 hr after the treatment. The body weight of fetuses in the NaAsO<sub>2</sub> 30 mg/kg significantly declined, compared to those of the control group. Pyknotic neuroepithelial cells increased significantly in the telencephalon of the NaAsO<sub>2</sub> 30 mg/kg group.</p> <p>[2] Pregnant rats were treated intraperitoneally with 20 mg/kg of NaAsO<sub>2</sub> on gestation day 13, and the cerebellums of infants were examined histopathologically postnatal day 7, 8 and 9. In the cerebellum of the NaAsO<sub>2</sub> group, apoptosis in the external granular layer and thinning of the molecular layer were observed.</p> <p>[3] Pregnant rats were treated intraperitoneally with 10 mg/kg of NaAsO<sub>2</sub> on gestation day 11-15, and the fetuses were examined gestation day 16. In the NaAsO<sub>2</sub>-treated group, fetal death and fetal resorption were induced.</p> <p>These results suggest that single dose and multiple dose in gestation period have an adverse effects upon fetuses and infants in rats.</p>

一般研究 46 General Research 46	対応教員 Corresponding Staff	黒崎 泰典 Kurosaki, Yasunori
研究代表者 Principal Researchers	関山 剛 (気象庁局気象研究所) Sekiyama, Tsuyoshi (Meteorological Research Institute, Japan Meteorological Agency)	
研究課題 Research Subject	気象庁エアロゾル数値モデルによる全球ダスト分布の再現 Global dust distribution simulated by the JMA numerical aerosol model	
研究分担者 Co-researchers	田中 泰宙 (気象庁気象研究所) 大西 一成 (鳥取大学医学部) 眞木 貴史 (気象庁気象研究所) 篠田 雅人 (鳥取大学乾燥地研究センター) Tanaka, Taichu (MRI, JMA) Onishi, Kazunari (Faculty of Medicine, Tottori University) Maki, Takashi (MRI, JMA) Shinoda, Masato (Arid Land Research Center, Tottori University)	
共同研究要旨 Summary of Joint Research	<p>A global aerosol simulation in 2013 was performed by MASINGAR mkII which is a chemistry transport model developed by the Meteorological Research Institute (MRI). The horizontal resolution was TL319 (approximately 50 × 50 km) and the vertical resolution was 40 layers from surface to stratopause. MASINGAR includes 5 aerosol species; sulfate, black carbon, organic carbon, mineral dust, and sea salt particles. To validate the simulation result, we used PM 2.5 concentration measured by the Atmospheric Environmental Regional Observation System (AEROS) of the Japan Environment Ministry.</p> <p>The time series of PM 2.5 concentration measured or simulated over Tottori prefecture (Tottori City and Yonago City) indicates that the MASINGAR simulation has a good agreement with the AEROS observations. Furthermore, the AEROS PM 2.5 data showed that a polluted plume ran over Tottori prefecture on 11 July and 12 July in 2013; the MASINGAR simulation indicated that this polluted plume originated from Mt. Sakura at South Kyushu. According to the MASINGAR simulation, the polluted plume mainly consisted of the sulfate aerosol generated by photolysis from the volcanic smoke (sulfur dioxide) of Mt. Sakura.</p> <p>We confirmed the performance of MASINGAR to simulate aerosol emission, generation, advection, and deposition processes. We are going to practice an Asian Dust (Kosa) trajectory analysis using MASINGAR in the next fiscal year.</p>	

一般研究 47 General Research 47	対応教員 Corresponding Staff:	辻本 壽 Tsujimoto, Hisashi
研究代表者 Principal Researchers	執行 正義 (山口大学農学部) Shigyo, Masayoshi (Faculty of Agriculture, Yamaguchi University)	
研究課題 Research Subject	ニンニクにおける耐乾性系統の探索とその育種利用 Exploration of drought resistance clones in garlic and their utilization for breeding purposes	
研究分担者 Co-researchers	平田 翔 (鳥取大学大学院連合農学研究科) Hirata, Sho (The United Graduated School of Agricultural Sciences, Tottori University)	
共同研究要旨 Summary of Joint Research	<p>The purpose of this study is to evaluate the growth traits of garlic in arid soil conditions in order to select drought tolerance lines. A total of 109 lines (garlic bulbs of 105 lines collected from around the world and 4 lines of great-headed garlic) introduced from Yamaguchi University were used as plant materials. Cloves for</p>	

each line were planted in a trial field of the Arid Land Research Center, Tottori University, at the end of October 2012 and harvested in July 2013. Formed bulbs and roots were inferior to those of a field trial test in Yamaguchi. However, some lines formed bulbs vigorously. The plant roots of these bulbs were more than 30 cm, and put down not only an upper dry sand layer, but also a deeper wet sand layer in the fields. There was a high correlation between the formed bulb weight and the dry weight of the developed roots ( $r = 0.861$ ). However, there was no correlation between some saponin compound contents from the garlic root data in Yamaguchi and the formed bulb weight and dry weight of the roots ( $r = 0.110$  and  $r = 0.127$ , respectively). The TLC (thin-layer chromatography) saponin spot profiling in Yamaguchi showed a tendency for some lines growing vigorously to have many saponin spots. From these results, it is suggested that garlic produces various kinds of saponin compounds in order to avoid suffering from arid stress and to obtain drought tolerance.

Additional, more detailed studies would be needed to evaluate selected valuable garlic lines and to reveal the relevance between saponin compounds and drought tolerance.

一般研究 48 General Research 48	対応教員 Corresponding Staff	辻本 壽 Tsujimoto, Hisashi
研究代表者 Principal Researchers	近江戸 伸子 (神戸大学大学院人間発達科学研究科) Ohmido, Nobuko (Graduate School of Human Development and Environment, Kobe University)	
研究課題 Research Subject	ジャトロファの早期開花組換えならびに花成に関する研究 The study of early flowering transgenic <i>Jatropha</i> and flower development	
共同研究要旨 Summary of Joint Research	<p>In this study, firstly callus surviving and shoot regeneration rate were evaluated in <i>Jatropha</i> tissue cultures from cotyledons. Shoot regeneration rate from surviving callus was 45.7% at 35-days culture, and then it was higher than previous studies.</p> <p>Secondly, we introduced the FT gene to <i>Jatropha</i> plant using <i>Agrobacterium</i> system. 15 plants and 7 plants are generated by the transformation for one day coexistence-culture with <i>Agro</i> and 2-days coexistence-culture, respectively. In one day coexistence-culture, shoot regeneration rate of up to 30-days culture on the basis of the number of callus was 17.5%. In two-day coexistence-culture, shoot regeneration rate of up to 30 days on the basis of the number of callus became 15.6%. The higher callus survival ratio than the previous studies should lead to improve the high shoot regeneration rate.</p> <p>Thirdly, regenerated shoots were carried on the test of the presence the FT gene in the genome of transformants. As the result, FT gene was detected in a leaf of transgenic FT plants. The current problem, although transformed plants were transferred in the root induction medium, is that a root developed was observed in only one plant. Stable root induction system from regenerated shoots is necessary for the next investigation. Next year, I promote the production of transformants, establishment of considerable rooting conditions, and analysis the expression of FT gene.</p> <p>Fourthly, it subjected to morphological observation of the several growth stages of flower buds from the sections of male and female flowers. Male flower has 10 anthers, 5 filaments, 5 petals, and 5 calyxes. The female flower has 3 ovules with the composition of 3 carpels, 5 petals, and 5 calyxes. In this study, I demonstrated the analysis of inflorescence formation of <i>Jatropha</i> on the basis for the morphological study of unisexual flower buds.</p>	

一般研究 49 General Research 49	対応教員 Corresponding Staff	辻本 壽 Tsujimoto, Hisashi
研究代表者 Principal Researchers	田中 裕之 (鳥取大学農学部) Tanaka, Hiroyuki (Faculty of Agriculture, Tottori University)	
研究課題 Research Subject	野生種タルホコムギ由来染色体部分領域をもつ耐乾性コムギ系統の育成と耐乾性分子機構の解明 Production of drought tolerant wheat lines with small chromosome regions of <i>Aegilops tauschii</i> and elucidation of molecular mechanism of drought tolerance	
共同研究要旨 Summary of Joint Research	<p>Common wheat has the largest plant area among crops in the world and is important as food. However, the quantity of production of common wheat has made little increase. Drought stress is mentioned as the factor. The quantity of production in Australia in 2006 to 2007 which was a severe drought was 9,819,000 tons. Compared with 25,367,000 tons of the previous year, it became a 41.7% fall (ABARE Australian GRAINS 2007. 2). Thus, drought stress has had serious influence on the food problem. In order to improve the yield in a dry land, the breeding of drought resistance in common wheat is effective.</p> <p>Wild-relative, <i>Aegilops tauschii</i> is one of the ancestor parents of common wheat, and is known as resources of the useful genes about wide adaptability and/or bread-making quality. In this research, we try to introduce the partial chromosome regions carrying some useful genes for drought resistance in <i>Ae. tauschii</i> into common wheat, and study the molecular mechanism of drought resistance. We studied in this fiscal year as follows.</p>	

	<p>1. As a result of analyzing comprehensively the gene which participates in the improvement in drought resistance, the gene which accumulates a compatible solute and raises osmotic pressure was able to be found out. Now, the primer which can amplify a gene by the PCR method based on the sequence of this gene was designed, and development of the DNA marker which can identify the useful gene of <i>Ae. tauschii</i> is tried.</p> <p>2. In order to determine the chromosome carrying the useful genes for drought resistance, the segregating population of drought resistance was raised for genetic analysis. Sowing of this population was carried out in the experimental field of Arid Land Research Center, Tottori University.</p>	
一般研究 50 General Research 50	対応教員 Corresponding Staff	安 萍 An, Ping
研究代表者 Principal Researchers	岡 真理子 (鳥取大学農学部) Oka, Mariko (Faculty of Agriculture, Tottori University)	
研究課題 Research Subject	高塩濃度環境下における塩生植物の成長生理機構の解明 Physiological mechanisms of growth and development in halophyte under high salinity conditions	
研究分担者 Co-researchers	高田 明良 (鳥取大学大学院農学研究科) Takata, Akira (Grad. School of Agriculture, Tottori University)	
共同研究要旨 Summary of Joint Research	<p>The growth of <i>Salicornia</i> seedlings was substantially promoted by the addition of NaCl in continuous light and dark conditions due to decrease of viscoelastic properties of the cell wall in hypocotyls. Since the change of the cell wall polysaccharides is involved in cell wall loosening by decrease of viscoelastic properties, we investigated the polysaccharide contents and the profiles of molecular weight of hemicellulose 1 and hemicellulose 2 polysaccharide in the cell wall of <i>Salicornia</i> hypocotyls with the addition of NaCl.</p> <p>The contents of cellulosic, hemicellulosic and pectic polysaccharides in hypocotyls decreased in continuous light conditions. The contents of cellulosic, hemicellulosic polysaccharides decreased in dark conditions. The content of xyloglucans, which are a group of hemicelluloses coating and cross-linking crystalline cellulose in the plant cell wall, decreased in hypocotyl applied with NaCl under both light conditions. Moreover, hemicellulose molecules are cleaved to form small molecules in the presence of NaCl. On the other hand, extensibility of the cell wall increased and the growth of hypocotyl promoted in the presence of NaCl in the dark compared to that in the light.</p> <p>These results suggest that NaCl affects the metabolism of cell wall polysaccharides and cell wall extensibility, and then promotes the elongation of <i>Salicornia</i> hypocotyls by promoting the cell wall loosening.</p>	
一般研究 51 General Research 51	対応教員 Corresponding Staff	安 萍 An, Ping
研究代表者 Principal Researchers	岡元 英樹 (北海道立総合研究機構上川農業試験場天北支場) Okamoto, Hideki (Tenpoku Branch, Kamikawa Agricultural Experiment Station, Hokkaido Research Organization)	
研究課題 Research Subject	土壌の種類と水分が寒地型牧草の根系発達に及ぼす影響 The effect of species and moisture of soil on root system development of temperate grasses	
研究分担者 Co-researchers	笹木 正志 (北海道立総合研究機構上川農業試験場天北支場) 松原 哲也 (北海道立総合研究機構上川農業試験場天北支場) Sasaki, Masashi (Tenpoku Branch, Kamikawa Agricultural Experiment Station, Hokkaido Research Organization) Matsubara, Tetsuya (Tenpoku Branch, Kamikawa Agricultural Experiment Station, Hokkaido Research Organization)	
共同研究要旨 Summary of Joint Research	<p>This study using root box evaluated the effects of soil types on the root development and drought tolerance of four temperate grass species: <i>Lolium perenne</i> L., <i>Phleum pratense</i> L., <i>Dactylis glomerata</i> L., and <i>Bromus inermis</i> Leys. The experiment was conducted in a plant growth chamber set at 18°C, with 14 hr day length. Root boxes (25 cm width, 40 cm depth, and 3 cm thickness) were filled with volcanogeneous soils. Two months after germination, soil moisture treatments (30 days) were started. Root boxes with each grass species were subjected to either dry or control treatment. At the end of treatment, root boxes were decomposed and soils in root boxes were divided vertically into four blocks (10 cm depth each), and horizontally into two blocks (inside or outside 5 cm from the plant base). Root samples were collected from each block. The root length density was measured using WinRhizo. Then their dry weight was recorded.</p> <p>Unlike the result of brown forest soil, root systems of all grasses developed well in wet treatment, even in the deepest outside zone. In dry treatment, <i>P. pratense</i> and <i>B. inermis</i> showed the decline of root length density in the zone deeper. In the zone shallower than 20 cm, the dry treatment decreased the root length in <i>D. glomerata</i> and <i>L. perenne</i>, however, the root length density of the dry treatment was higher than that of the wet treatment in <i>P. pratense</i> and <i>B. inermis</i>. In the zone deeper than 20 cm, <i>P. pratense</i> and <i>B. inermis</i> showed the decline of root system development, and <i>D. glomerata</i> and <i>L. perenne</i> showed it in the deepest zone (30–40 cm).</p> <p>Results showed that the different effect of soil type on root development and drought tolerance in root system varied among grass species.</p>	

一般研究 52 General Research 52	対応教員 Corresponding Staff	恒川 篤史 Tsunekawa, Atsushi
研究代表者 Principal Researchers	山本 定博 (鳥取大学農学部) Yamamoto, Sadahiro (Faculty of Agriculture, Tottori University)	
研究課題 Research Subject	自然熱エネルギー利用による根域加温と有機物施与による低コスト高品質野菜栽培砂ベッドシステムの開発 Development of low-cost sand culture system for production of high-quality vegetables by applying organic fertilizer and root zone heating using natural heat energy	
研究分担者 Co-researchers	遠藤 常嘉 (鳥取大学農学部) 西原 英治 (鳥取大学農学部) Endo, Tsuneyoshi (Faculty of Agriculture, Tottori University) Nishihara, Eiji (Faculty of Agriculture, Tottori University)	
共同研究要旨 Summary of Joint Research	<p>For the stable production and improvement of crop quality, control of cultivation environment is essential. In this study, a sand-bed culture experiment was conducted to ascertain the effect of root-zone temperature control on root-zone soil conditions, and the growth and quality of Komatsuna (Japanese mustard spinach (<i>Brassica rapa</i> var. <i>perviridis</i>)). Root-zone soil temperature was varied by circulating cold or warm water produced by natural energy under greenhouse conditions. Additionally, the effect of various fertilizer treatments (Organic; OM, Inorganic; IN and a mixture 50% OM+50% IN; OI) were also assessed. The following results were obtained;</p> <p>1) Root-zone cooling experiment in summer season: Circulation of cold water (13–17°C-representing/assuming ground water use) for 12 hours during daytime resulted in a decrease in the maximum root-zone soil temperature by 5–7°C as compared to the control. Promotion of emergence rate (30%), increase in dry matter yield (200%) and ascorbic acid (AA) content (25%) of harvested crop were observed. The influence of cooling on nitric acid (NA) content of the crop was unclear, but NA content in OM fertilizer plot was lower than that in IN and OI. The cooling hardly influenced the chemical characteristics of post cultivation soil characteristics under all the fertilizer treatments.</p> <p>2) Root-zone heating experiment in winter season: Circulation of warm water (35–40°C (representing/assuming hot spring and/or sun-warmed water use) for 5–14 hours before sunrise resulted in an increase in root-zone soil temperature by 5–10°C as compared to the control. Emergence and growth of Komatsuna were greatly boosted by the warming. Dry matter yield increased by 1.5–3 times; the effect was remarkable in OM fertilizer plot. Ascorbic acid content also increased in OM (30%), but was unclear in IN and OI, which received inorganic N. Although NA content was less than 500 ppm under all the fertilizer plots, content slightly increased with warming. Soil EC under the warming treatment rose 1.5-fold.</p> <p>In conclusion, the partial temperature control of root zone was effective in the improvement of growth and quality of Komatsuna, especially, the case of organic fertilizer application under the cold temperature period where root-zone warming showed a profound effect.</p>	
一般研究 53 General Research 53	対応教員 Corresponding Staff	恒川 篤史 Tsunekawa, Atsushi
研究代表者 Principal Researchers	児玉 基一郎 (鳥取大学農学部) Kodama, Motoichiro (Faculty of Agriculture, Tottori University)	
研究課題 Research Subject	トマト野生種を用いた各種ストレス耐性の分子機構研究 Molecular mechanisms of stress resistance in wild tomatoes	
共同研究要旨 Summary of Joint Research	<p>Tomato plants were originated from South and Central American countries. Several wild species are still grown in those counties such as Mexico, Peru and Chile. Those wild tomato species are known to be tolerant to several stresses, e.g. drought, diseases, salinity and high/low temperature. The objective of the research project is to understand the molecular mechanisms for the stress tolerance and to develop the new stress-tolerant plants based on the understandings of the mechanisms. Tomato seeds of wild species were collected through field survey of South and Central American countries and also were given by the Tomato Genetics Resource Center, UC-Davis. Those species were grown in the Arid Land Dome of Arid Land Research Center. Many wild species of tomato were well grown in the Arid Land Dome through the year. Disease resistance of the wild tomatoes was examined this year using <i>Alternaria alternata</i> tomato pathotype, the causal agent of the tomato stem canker disease. As results, almost all wild species are tolerant to the disease except the wild tomatoes, <i>S. cheesmaniae</i> and <i>S. galapagense</i>, only grown in Galapagos islands, Ecuador. These species have large deletion (ca. 400 bp) at the resistant gene <i>Asc 1</i>, and this might be a cause for susceptibility to the disease.</p>	

一般研究 54 General Research 54	対応教員 Corresponding Staff	藤巻 晴行 Fujimaki, Haruyuki
研究代表者 Principal Researchers	竹内 真一 (南九州大学環境園芸学部) Takeuchi, Shinichi (Faculty of Environmental Horticulture, Minami Kyushu University)	
研究課題 Research Subject	灌水方式が幹・茎内の放射方向の蒸散流移動分布特性へ及ぼす影響について Does irrigation method influence radial distribution of sap flow velocity in the stem and trunk ?	
共同研究要旨 Summary of Joint Research	<p>Recently, many scientist employ sap flow measurements in arid land researches, nevertheless it is not clear that irrigation method such as drip irrigation with small wetted volume or surface irrigation with large wetted volume affect the results of sap flow measurements. To investigate that irrigation method influence radial distribution of sap flow velocity in the stem and trunk, a Magnolia tree after transplantation work and corn plants were measured with woody and herbaceous heat pulse methods. For Magnolia tree, the heat ratio method which could detect two points in the trunk was applied. The seasonal curve of sap flow shows good root development and success of transplantation. The outer flow became relatively higher than inner flow in the trunk with time progress. The ratio of sap flow in the inner/outer water conducting area was increased slightly after large amount of irrigation event. In case of corn with potted plant, heat pulse velocity measured with different depth in the stem cross-sectional area was compared with transpiration rate obtained by weighing method. The wetting pattern was altered from the center part to outer rim of large pot. At the measurement depth 3 mm close to stem surface, (d=21 mm), the flow with outer irrigation was also slightly increased. In case of field experiments with corn plant, the velocity at 2.8 mm was low while the velocity at 7.5 mm and 5.5 mm from stem surface was high under drip irrigated condition. After additional watering for increasing wetted area, sap flow rate from outer section was increased. Additionally, covering lower 4 leaves treatment induced 50% reduction of heat pulse velocity at 3 mm depth. Although this can be interpreted in terms of integration, these findings need further considerations.</p>	

一般研究 55 General Research 55	対応教員 Corresponding Staff	藤巻 晴行 Fujimaki, Haruyuki
研究代表者 Principal Researchers	西村 拓 (東京大学大学院農学生命科学研究科) Nishimura, Taku (Graduate School of Agr. and Life Sciences, The University of Tokyo)	
研究課題 Research Subject	気候変動下の土壌水分予測における土壌構造変化の寄与 Contribution of the change in soil structure on prediction of soil moisture under climate change	
研究分担者 Co-researchers	加藤 千尋 (東京大学大学院農学生命科学研究科) Kato, Chihiro (Graduate School of Agr. and Life Sciences, The University of Tokyo)	
共同研究要旨 Summary of Joint Research	<p>Prediction of soil physical condition is critical to evaluate transition of plant ecology and sustain proper agricultural production under arid and semi-arid climate. In this study, we are planning to begin a new study that compare and evaluate an extent of effects coming from changes in soil structure on uncertainty of prediction of soil moisture and thermal conditions relative to those coming from uncertainty of projected future climate data. Experiments using rainfall simulator equipped in the Arid-dome of ALRC of Tottori-U has been conducted March 2014. During the rainfall experiment, soil water pressure and volumetric water contents were monitored. Prior the experiment effect of temporal resolution on results of numerical simulation of soil moisture and temperature was studied. Actually, most of projected future climate data is monthly or weekly. This level of temporal resolution is insufficient for proper soil moisture prediction by numerical simulation. Thus, we tried to make temporal downscale of daily climate data into hourly data. Combination of CLIGEN weather generator proposed by USDA-ARS and LARS-WG weather generator (Wallis and Griffiths, 1995) could make us possible to simulate soil moisture using future climate data with Hydrus-1D.</p>	

一般研究 56 General Research 56	対応教員 Corresponding Staff	藤巻 晴行 Fujimaki, Haruyuki
研究代表者 Principal Researchers	猪迫 耕二 (鳥取大学農学部) Inosako, Koji (Faculty of Agriculture, Tottori University)	
研究課題 Research Subject	低透水性土壌に適したリーチング方法の開発 Development of adequate leaching method for low-permeability soil	
共同研究要旨 Summary of Joint Research	<p>Leaching process under the condition of existence of a coarse-textured soil layer (CB layer) was investigated by laboratory and numerical experiments in this study. The following points were clarified from laboratory experiments, 1) The existence of capillary barrier (CB) increased water content in top soil layer. 2) When matric potential at a boundary point between the top soil and the CB layers become nearly 0 cm, the soil water began to infiltrate into the CB layer. 3) When the potential decreased and the boundary returned to</p>	

unsaturated condition, the CB layer cut off the infiltration again. Therefore water content of the top layer was kept at the wet condition. 4) Water was supplied from soil surface again, the cut-off effect was immediately disappeared and infiltration from top soil to lower soil re-started. In the soil with high permeability, accumulated salts was dissolved and flushed from the top layer to lower layer at the first stage of leaching and low concentrated water remained in the top soil. According to the numerical experiments using HYDRUS 2D/3D code, in low permeability soil, it took very long time for percolation of water. As result, the cut-off effect of the CB layer was unremarkable for percolation.

一般研究 57 General Research 57	対応教員 Corresponding Staff	山中 典和 Yamanaka, Norikazu
研究代表者 Principal Researchers	大手 信人 (東京大学大学院) Ohte, Nobuhito (Graduate School of Agricultural and Life Sciences, The University of Tokyo)	
研究課題 Research Subject	モンゴルの乾燥地生態系における key resource 群落の水・物質循環からみた成立要因の解明 Study on the factors for “Key resource” community establishment in the Mongolian semi-arid ecosystems using hydrological and biogeochemical approaches	
研究分担者 Co-researchers	遠藤 いず貴 (東京大学大学院農学生命科学研究科) 田中 あゆみ (森林総合研究所立地環境研究領域) 額尔德尼 (東京大学大学院農学生命科学研究科) Endo, Izuki (Graduate school of Agricultural and Life Sciences, The University of Tokyo) Tanaka, Ayumi (Department of Forest Site Environment, Forestry and Forest Products Research Institute) Eerdeni (Graduate school of Agricultural and Life Sciences, The University of Tokyo)	
共同研究要旨 Summary of Joint Research	<p>In semi-arid regions of Mongolia, the perennial grass <i>Achnatherum splendens</i> is a “key-resource” that is important for the survival of livestock during harsh climate conditions. <i>A. splendens</i> forms dense communities on river banks or on mounds on sandbars. To understand how this species develops dense communities, we investigated soil conditions and the amount of below-ground biomass based on the hypothesis that the below-ground biomass contributes to the amount of the above-ground growth and community density.</p> <p>We set three transect lines from the river to the adjacent upper slope because soil moisture levels vary greatly with ground height above the river. We set experimental plots in dense and sparse <i>A. splendens</i> communities on each transect line. Amounts of above- and below-ground biomass were measured. Buried stems implied that the ground surface had been raised from a previously lower level. The size distributions of soil particles were compared between the plots having different community densities.</p> <p>The amounts of above-ground and buried stem biomass were significantly higher in the dense communities. A positive correlation between these two factors indicated that below-ground growth contributed to the development of the above-ground biomass. Because adventitious roots form on the buried stems, the buried stems act as a source of new roots, which can extend the water and nutrient absorption area in the soil profile. Soil particles at the surface horizon in the dense communities were homogeneous fine sand, while soil particle sizes at a depth of 50–80 cm were larger and heterogeneous. These results indicated that a dry sand layer can form on the surface of river bank soil, which prevents evaporative loss of soil water.</p> <p>We conclude that <i>A. splendens</i> takes advantage of the movement and deposition of fine sand that occurs during flooding to extend the area from which it can absorb water leading to the development of dense communities.</p>	

一般研究 58 General Research 58	対応教員 Corresponding Staff	恒川 篤史 Yamanaka, Norikazu
研究代表者 Principal Researchers	松永 光平 (慶應義塾大学政策・メディア研究科) Matsunaga, Kohei (Graduate School of Media and Governance, Keio University)	
研究課題 Research Subject	黄土高原の農村レベルにおける気候変動適応可能な生業転換モデルの研究 A Model for Livelihood Transitions Enabling Climate Change Adaptation at Village Level on the Loess Plateau	
研究分担者 Co-researchers	佐藤 廉也 (九州大学比較社会文化研究科) 村松 弘一 (学習院大学学長付国際研究交流オフィス) Sato, Renya (Graduate School of Social and Cultural Studies, Kyushu University) Muramatsu, Koichi (Global Exchange Office for Research and Education, Gakushuin University)	
共同研究要旨 Summary of Joint Research	<p>Since 1999, in villages on the Loess Plateau in China, a rapid increase in afforestation and grassland reclamation by the “Grain for Green” project has led to a livelihood transition from conventional subsistence agriculture to commercial activities or mining activities such as oil and gas development. It is likely that this transition and the decrease in current and potential arable land caused by afforestation will potentially lead to water and land scarcity. Moreover, it is possible that the frequency of droughts and floods will increase due to climate change. Then forest or grassland will again be replaced by arable land, for subsistence. Thus this study is aimed at clarifying how to use water and land resources to adapt to a rapid decrease in precipitation. Its purpose is also to model how agriculture can coexist with environmental protection, economic and energy development.</p> <p>Our methods are as follows: We chose Ansai County in Shaanxi Province as one of our study areas be-</p>	

cause of the research collaboration that occurred there between Tottori University's Arid Land Research Center and the Chinese Academy of Science's Institute of Soil and Water Conservation. To investigate the effects of natural or social conditions on livelihood transition, we chose Luochuan County, also in Shaanxi Province, as the other research area. First, we clarified the characteristics of livelihood transition and their impact on local water and land resources by using interviews, statistical analysis of hydrological and socio-economic data, and satellite image analysis.

Second, we constructed possible livelihood transition scenarios for climate change adaptation in the Loess Plateau.

一般研究 59 General Research 59	対応教員 Corresponding Staff	山中 典和 Yamanaka, Norikazu
研究代表者 Principal Researchers	宮沢 良行 (九州大学東アジア環境研究機構) Miyazawa, Yoshiyuki (Institute for East Asia Environments, Kyushu University)	
研究課題 Research Subject	ニセアカシアの蒸散特性と土壌乾燥への適応の解明 Investigation of transpiration regulation of <i>Robinia pseudoacacia</i> in response to soil drought	
共同研究要旨 Summary of Joint Research	A large area in Loess plateau is covered by a plantation species, <i>Robinia pseudoacacia</i> . Because of the high capacity for transpiration, there is a growing concern about the possible threat to the local water resources. In order to predict/project the transpiration rates, knowledge about the ecophysiological traits as well as the environments are necessary, although less is understood about the biology of <i>Robinia</i> , especially about the responses to the drought. This study investigated the changes in transpiration rates and the related ecophysiological traits of <i>Robinia</i> growing in Tottori University to identify the mechanism underlying the quick reduction in transpiration rates in response to the increased evaporative demand. Results suggested that reduction in transpiration (and stomatal closure) occurred in mid summer but not in spring. In summer, stomatal closure started before midday both before and after a high rainfall event, suggesting that stomatal closure was not due to the soil drought. The stem conductivity, which is the ratio of sap flux to the difference in water potential between the root and leaf, did not change before and after stomatal closure, showing that stomatal closure was not the result of reduced stem conductivity but the spontaneous response of the leaves to the increasing atmospheric evaporative demand in order to avoid reduction in stem conductivity and resultant cavitation. The stomatal control to prevent cavitation should be validated by other analyses based on the independently obtained data, and the comparison of the measured and modeled transpiration rates on the assumption of the stomatal control for cavitation avoidance. Further studies are necessary because these analyses were carried out using measured data on only three time points.	

一般研究 60 General Research 60	対応教員 Corresponding Staff	山中 典和 Yamanaka, Norikazu
研究代表者 Principal Researchers	三木 直子 (岡山大学大学院環境学研究科) Miki, Naoko (Graduate School of Environmental and Life Science, Okayama University)	
研究課題 Research Subject	温帯性広葉樹における通水機能の維持機構 Maintenance mechanisms of water transport in temperate broad-leaved tree species	
研究分担者 Co-researchers	吉川 賢 (岡山大学環境学研究科) 楊 靈麗 (岡山大学) 久堀 史暁 (岡山大学農学部) 粟飯原 友 (岡山大学農学部) Yoshikawa, Ken (Graduate School of Environmental Science, Okayama University) Yang, Lingli (Okayama University) Kubori, Fumiaki (Faculty of Agriculture, Okayama University) Aihara, Tomo (Faculty of Agriculture, Okayama University)	
共同研究要旨 Summary of Joint Research	To clarify a contribution of stored water to the maintenance of water transport, we evaluated the water storage capacity and hydraulic properties in seven temperate deciduous broad-leaved trees ( <i>Carpinus tschonoskii</i> , <i>Cerasus jamasakura</i> , <i>Betula platyphylla</i> var. <i>japonica</i> , <i>Salix integra</i> , <i>Salix psammophila</i> , <i>Salix babylonica</i> and <i>Salix cheilophila</i> ). As the water storage capacities, capacitance under slight dehydration (Clinear) (Meinzer et al. 2003) and under severe dehydration ( $\Psi_{xylem}$ : almost $\Psi_{50}$ ) (C $\Psi_{50}$ ) were evaluated. Vulnerability curves (VCs) were evaluated with stem segments using the centrifuge technique. Xylem water potential at 50% loss of hydraulic conductivity ( $\Psi_{50}$ ), which indicates resistance to xylem cavitation, was obtained. Xylem recovery index (XRI), midday xylem water potential ( $\Psi_{50}$ min) and wood density were also studied. Species with less xylem resistance to cavitation had smaller safety margin and large capacitances (Clinear, C $\Psi_{50}$ ). Although species with less xylem resistance to cavitation had larger risk to hydraulic dysfunction, they would avoid the loss of hydraulic conductivity by the buffer of water fluctuation from the use of water storage in the initial phase of dehydration, and would recover the hydraulic conductivity by the refilling with the water storage in the severe phase of dehydration. These results suggest that species with less resistant and safety to cavitation would use the stored water for the avoidance of hydraulic dysfunction and the recovery of hydraulic function, and would maintain the water transport.	



(3) 若手奨励研究 / Incentive Research by Young Scientists

若手奨励研究 1 Incentive Research by Young Scientists 1		対応教員 Corresponding Staff	安田 裕 Yasuda, Hiroshi
研究代表者 Principal Researchers	齊藤 忠臣 (鳥取大学農学部) Saito, Tadaomi (Faculty of Agriculture, Tottori University)		
研究課題 Research Subject	樹体内水分モニタリングと水の安定同位体分析を用いた乾燥地樹木の水利利用戦略解明 Clarification of water use strategy of trees in arid lands based on tree water monitoring and water stable isotope ratio analysis		
共同研究要旨 Summary of Joint Research	<p>Clarification of water use strategy of trees in arid lands based on tree water monitoring and water stable isotope ratio analysis</p> <p>The objective of this study is to clarify the water use strategies of trees in arid environments based on soil-tree water monitoring and stable isotope ratio analysis of water. Target trees were Screwbean mesquite (<i>Prosopis pubescens</i>: native species) and tamarix (<i>Tamarix ramosissima</i>: invasive species) in North America and mesquite (<i>Prosopis juliflora</i>: invasive species) in Sudan. One research site (Riverside, NV) and three research sites (Alkadaro, Soba, Elrawakeeb) were established in America and Sudan, respectively in 2012. Two - four representative trees were selected in each site. The stem of each tree was bored with a drill and then the GS3 sensors were installed to the stem. Since the outputs from the sensors were severely affected by the temperature, calibration equations to reduce the temperature effect were derived using time series of output data. For isotope analysis, stems (or branches) were cut per one tree about every month. The branches were chopped and then bottled in glass bottles. Soil (0-30 cm) and groundwater samples were also taken using bottles about every month in each site. Rainwater samples were taken only in Al Rawakeeb site.</p> <p>The results from the sensor installed in the stems in Sudan showed that the stem water content increased with increase in the soil water content blow 15 cm deep after heavy rainfall events. The stem water content started decreasing when the soil water potential fell below the primary wilting point of the soil blow 15 cm deep. These results indicating that the <i>Prosopis</i> trees used the soil water below 15 cm deep in the rainy season, although they are regarded as to use ground water through deep tap roots.</p> <p>The results from stable isotope ratio analysis of water showed that mesquite in Sudan used not only ground water but also deep soil water especially in rainy season. In America, both mesquite and tamarix used shallow saline ground water, suggesting that not only tamarix but also mesquite are salt tolerant species.</p>		
若手奨励研究 2 Incentive Research by Young Scientists 2		対応教員 Corresponding Staff	安 萍 An, Ping
研究代表者 Principal Researchers	近藤 謙介 (鳥取大学農学部) Kondo, Kensuke (Faculty of Agriculture, Tottori University)		
研究課題 Research Subject	蔬菜の養液栽培における塩水の利用 Utilization of saline water in soilless culture system for growing vegetables		
共同研究要旨 Summary of Joint Research	<p>Soilless culture is able to grow plants in any soil or soilless condition. Objective of this study is in order to get basic data for introducing the soilless culture at arid or semiarid land. It was investigated that effects of different concentration of salt in nutrients solution on the growth and quality of vegetable in a hydroponic system with deep flow technique. It was showed that growth and quality of Mizuna were affected by nutrient solutions with different NaCl contents in 2012. It was investigated that effects of another type of salt on the growth and inorganic contents of vegetables in the hydroponic system in 2013. Seeds of Mizuna were sown in urethane mat and grown with tap water in glasshouse about 14 days. Plants having two leaves were transplanted to the hydroponic system and grown for 28 days. Nutrient solution was adjusted with reagents based on a quarter strength of Otsuka A solution. The experiment comprised three different CaO and MgO concentrate nutrient solutions, which was five, twenty, and fifty times concentrate compare with control, respectively. The growth of Mizuna was not inhibited fifty times CaO and five times MgO treatments. Ca contents of Mizuna were increased in control to fifty times treatment. Mg contents of Mizuna were increased in control to twenty times treatments.</p>		
若手奨励研究 3 Incentive Research by Young Scientists 3		対応教員 Corresponding Staff	藤巻 晴行 Fujimaki, Haruyuki
研究代表者 Principal Researchers	小林 幹佳 (筑波大学生命環境系) Kobayashi, Motoyoshi (Faculty of Life and Environmental Sciences, University of Tsukuba)		
研究課題 Research Subject	土壌コロイドの界面化学特性に基づく土壌改良剤の侵食抑制機能の解明 Elucidation of the control mechanism of soil erosion by soil conditioners on the basis of colloidal properties of soil particles		
共同研究要旨 Summary of Joint Research	We studied the relationship between colloidal properties of Tottori Masa soil and the surface runoff from the soil under the influence of raindrop impact generated by a compact rainfall simulator. In addition, we evaluated the effect of application of poly-ion complex (PIC) as a soil amendment.		

	<p>Obtained results are as follows:</p> <p>(1) The zeta potential of the soil was pH-dependent negative value, indicating that the soil is negatively charged. The magnitude of the zeta potential of the soil increased with increasing pH. Flocculation behavior of the soil particles qualitatively follows the classical DLVO theory.</p> <p>(2) The surface runoff induced by rainfall was enhanced at high pH, where the soil particles are highly charged and electrostatically dispersed. We think that detached particles induce the formation of crust with low hydraulic conductivity. Even in the rapid coagulation regime, where the electric repulsive force is negligible, the runoff by 1 mM CaCl<sub>2</sub> rainfall was less than that by 10 mM NaCl. This behavior cannot be explained within the framework of the classical DLVO theory. We suggest that calcium ions provide an additional particle-particle binding force and thus reduce the surface runoff by inhibiting the formation of soil crust.</p> <p>(3) PIC significantly reduced the surface runoff as well as soil erosion even under the influence of raindrop impact. The reductions demonstrate that PIC stabilizes the soil structure through the formation of bridge between soil particles.</p>
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若手奨励研究 4 Incentive Research by Young Scientists 4	対応教員 Corresponding Staff	山中 典和 Yamanaka, Norikazu
研究代表者 Principal Researchers	衣笠 利彦 (鳥取大学農学部) Kinugasa, Toshihiko (Faculty of Agriculture, Tottori University)	
研究課題 Research Subject	モンゴル草原における低嗜好性雑草 <i>Artemisia adamsii</i> の定着と拡大 Establishment and expansion of a low palatable weed, <i>Artemisia adamsii</i> , in the Mongolian steppe	
共同研究要旨 Summary of Joint Research	<p><i>Artemisia adamsii</i> is a perennial weed that rapidly expands after colonizing disturbed areas. In a Mongolian steppe, <i>A. adamsii</i> distribution is expanding because of human disturbances such as overgrazing. As <i>A. adamsii</i> is low palatable for livestock, its expansion decreases the quality of pasturelands. Therefore, colonization and expansion of <i>A. adamsii</i> should be controlled to maintain the value of Mongolian pasturelands. <i>A. adamsii</i> produces several small seeds and expands via rhizomes. Thus, to control the colonization and expansion of <i>A. adamsii</i>, seed germination potential and rhizome elongation must be understood. We investigated <i>A. adamsii</i> seed production and seed germination characteristics in 2012 and evaluated rhizome elongation ability in 2013.</p> <p>In the surveyed <i>A. adamsii</i> population in the Mongolian steppe, seed production was calculated to be approximately 160,000 per square meter. Seed germination under light conditions demonstrated temperature dependency with an optimal temperature of approximately 18°C, in which percent seed germination was approximately 80%. Percent seed germination under dark conditions was lower than under light conditions. Germinated plants produced more than 60 ramets in six months, and the maximum distance from mother to daughter ramet was 27 cm.</p> <p>Taken together, in <i>A. adamsii</i>, approximately 80% of seeds germinate under sufficient light and optimal temperature, and germinated plants form a patch larger than 50 cm diameter in one growing season. Therefore, to suppress <i>A. adamsii</i> expansion, clear cutting of shoots before seed production with simultaneous prevention of dormant seed germination may be effective. As shoots are connected each other in wide range, the potential of shoot recovery after clear cutting should be investigated in a future study.</p>	

若手奨励研究 5 Incentive Research by Young Scientists 5	対応教員 Corresponding Staff	谷口 武士 Taniguchi, Takeshi
研究代表者 Principal Researchers	片岡 良太 (山梨大学生命環境学部環境科学科) Kataoka, Ryota (Faculty of Life and Environmental Sciences, Yamanashi University)	
研究課題 Research Subject	バイオフィーム形成細菌による塩類集積土壌での植物根の保護 Protection of plant root by using biofilm producing bacteria in the salt accumulation soil	
共同研究要旨 Summary of Joint Research	<p>The rhizo-bacteria were isolated from the rhizosphere soil of <i>Carex kobomugi</i> growing in the sea side of Arid Land Research Center, Tottori University last year. This year, biofilm produced by 5 species of bacteria was investigated. Moreover, the column test was also carried out getting information of Na trap by rhizo-bacteria.</p> <p>At first, monosaccharide was measured by phenol-sulfuric acid method. The result showed that the value of monosaccharide in <i>Bacillus</i> sp. #15 was the highest than other strains, following <i>Achromobacter</i> sp. #2, Unknown and <i>Lysinibacillus</i> sp. #19. The composition of biofilm is still unknown though HPLC analysis has been conducted. To reveal the effect of biofilm on Na trap, the diatomaceous earth was added to a syringe and incubated bacteria with PDB (pH7, adjusted by KOH) at 25°C for 2 weeks. Then 6 ml of NaCl (10 mM) was added from the upper of syringe, Na in the solution dropped from the lower of syringe was analyzed by MP-AES. The effect of Na trap is different among strains. <i>Achromobacter</i> sp. #2 was the most effective on the Na trap. In comparison between control and other strains, however, it was no significant differences, therefore, need to do that continuously. After that, we will try to improve the effect of Na trap parallel using the adsorption aid such as charcoal and zeolite.</p>	

若手奨励研究 6 Incentive Research by Young Scientists 6		対応教員 Corresponding Staff	篠田 雅人 Shinoda, Masato
研究代表者 Principal Researchers	河合 隆行 (新潟大学災害・復興科学研究所) Kawai, Takayuki (Research Institute for Natural Hazards and Disaster Recovery, Niigata University)		
研究課題 Research Subject	地下流水音と安定同位体を併用したモンゴル半乾燥草原の浅層地下水流況解析 Estimation of shallow groundwater flow system with groundwater aeration sound and stable-isotope probing in Mongolian semiarid steppe		
共同研究要旨 Summary of Joint Research	<p>This study aimed to develop a new exploration technique for shallow groundwater using the groundwater aeration sound (GAS).</p> <p>We conducted a survey using the existing wells in Bayan-Unjuul, the dry grasslands of Mongolia. Total number of wells is 84 and the measurement items are groundwater level, GAS, general water quality, and stable isotope ratio. Results indicated that logarithmic relationship between the GAS and groundwater levels. It was found that the groundwater level could be estimated easily by measuring the GAS value from the surface. Furthermore, the correlation of GAS level and groundwater level showed different trends in each geological condition.</p>		
若手奨励研究 7 Incentive Research by Young Scientists 7		対応教員 Corresponding Staff	安 萍 An, Ping
研究代表者 Principal Researchers	辻 渉 (鳥取大学農学部) Tsuji, Wataru (Faculty of Agriculture, Tottori University)		
研究課題 Research Subject	土壤乾燥ストレス下における切葉が作物の光合成および収量に及ぼす影響 Effects of defoliation on photosynthesis and yield in crops under drought stress		
共同研究要旨 Summary of Joint Research	<p>To develop crop cultivation technology which can harvest higher yield with reducing water consumption under soil drying condition, we focused on "Ratio of root length to leaf area" which is one of the factors deciding water absorption in plants. It has been reported that hydraulic conductivity and stomatal conductance enhances by increasing the ratio. So far, we found that photosynthetic rate of remaining upper leaves increase when lower leaves declining transpiration efficiency are excised under drought stress. Objectives of present study are to evaluate photosynthetic rate per plant of two crop species defoliated different strength under two soil moisture conditions. In addition, the effects of defoliation on grain yield and yield component are also investigated</p> <p>Two crop species, sorghum and maize were cultivated in pots. At booting stage, soil moisture treatment (wet and dry) and defoliation treatment (0%, 40%, 60% and 80%) were started. Photosynthetic rate and transpiration rate per plant were measured by chamber method and gravimetric method, respectively.</p> <p>As the results, regardless of species, photosynthetic rate per plant decreased with increasing strength of defoliation in wet soil condition. In dry condition, however, photosynthetic rate per plant in 40% and 60% defoliation treatments was higher than that in 0%. Transpiration rate per plant of both species declined with increasing strength of defoliation in wet condition, while it showed no significant differences among defoliation treatments in dry condition. On the other hand, Transpiration rate per leaf area increased with increasing strength of defoliation in both species in spite of soil moisture condition. Although grain yield of sorghum decreased with increasing strength of defoliation under wet condition, grain yield in 40% defoliation treatment showed the tendency that it is higher than that in other treatments in dry soil. This was attributed to increment of number of grains and 1000 grains weight. These results suggested that defoliation can mitigate the sterility and improve poor ripening under drought. In sorghum, water use efficiency of 40% defoliation treatment was higher than other treatments in dry condition.</p>		
若手奨励研究 8 Incentive Research by Young Scientists 8		対応教員 Corresponding Staff	Eltayeb Habora Amin
研究代表者 Principal Researchers	マニカベル アラグ (横浜市立大学木原生物学研究所植物遺伝資源科学研究部門) Manickavelu, Alagu (Plant Genetic Resources Division, Kihara Institute for Biological Research, Yokohama City University)		
研究課題 Research Subject	非生物的ストレスに対する小麦遺伝資源の評価と特性評価 Evaluation and characterization of wheat germplasm for abiotic stresses		
共同研究要旨 Summary of Joint Research	<p>I. Afghan wheat landraces along with check varieties Karahan and Chinese Spring was chosen. In total 123 wheat landraces were selected based on SNP marker diversity result and Turkey field data. High throughput hydroponics system was installed and osmotic stress was induced by 20% Polyethylene glycol (PEG). Two weeks stress was given and measured six various traits affected by stress. Based on correlation analysis, the traits which showing strong correlation with yield was identified. The best tolerance and susceptible accessions which are showing high performance in those four traits was selected. Overall, best genotypes Afghan wheat landraces under stress condition showed better root growth compared to control further resulted</p>		

	<p>in heavy root and shoot weight. Hence it is speculated that afghan landraces are having such root developing mechanism which might play a role under stress condition.</p> <p>II. Sixteen landraces along with three checks were studied at Joint research facility centre of ALRC, Tottori University. After germination, the pots were moved to growth simulator 5 and imposed stress by withholding water after tillers uniformly formed in all plants. Physiological data like chlorophyll content and fluorescence reading was taken. Drought recovery rate also recorded and found clear difference among the genotypes.</p> <p>III. In order to widen the wheat germplasm, study tour was made by visiting ARC, Sudan and evaluated wide germplasm developed from ALRC and other places.</p> <p>IV. Overall, the effect of early drought stress was studied and the methodology to screen drought stress was established</p>
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若手奨励研究 9 Incentive Research by Young Scientists 9	対応教員 Corresponding Staff	伊藤 健彦 Ito, Takehiko
研究代表者 Principal Researchers	吉原 佑 (東北大学農学部) Yoshihara, Yu (Graduate School of Agricultural Science, Tohoku University)	
研究課題 Research Subject	過放牧と乾燥化による種の消失が複数の生態系機能に与える影響の解明 Simulating species loss following overgrazing and aridification: assessing the effects on multiple ecological functions	
共同研究要旨 Summary of Joint Research	<p>Within Hustai National Park in Mongolia, we constructed a fence (100 m×100 m) in which we establish each 80 plots (3 m×3 m). We obtained the initial data of plant species composition and soil. Based on the vegetation data, we determined five levels (12, 8, 4, 2, 1) of plant species richness. We assume four extinction scenarios as following 1) dominant species extinct first; 2) rare species extinct first, 3) mixture of scenarios 1 and 2, 4) random scenario.</p> <p>According to the scenarios and species richness levels, we removed plant from the plots. We also collected the plant traits (leaf height, leaf size, leaf hardness, leaf weight, nitrogen and carbon contents, stem density) data. Litter bag for measuring soil decomposition rate was established in the plot.</p> <p>In the next summer, we will measure CO<sub>2</sub> flux and ANPP within the plot, and sample the litter bags.</p>	

#### (4) 研究集会 / Research Meeting

研究集会 1 Research Meeting 1	対応教員 Corresponding Staff	恒川 篤史 Tsunekawa, Atsushi
研究代表者 Principal Researchers	福井 希一 (大阪大学工学研究科) Fukui, Kiichi (Graduate School of Engineering, Osaka University)	
研究課題 Research Subject	ジャトロファ研究会 Jatropha Workshop	
研究分担者 Co-researchers	辻本 壽 (鳥取大学乾燥地研究センター) 安藤 孝之 (鳥取大学国際交流センター) 辻 渉 (鳥取大学農学部) 井上 知恵 (鳥取大学乾燥地研究センター) 笹井 智博 (大阪大学工学研究科) 竹本 高広 (大阪大学工学研究科) 酒井 啓江 (大阪大学工学研究科) モハメド アーメド (大阪大学工学研究科) 留森 寿士 (鳥取大学乾燥地研究センター) 土本 卓 (大阪大学工学研究科) Tsujimoto, Hisashi (Arid Land Research Center, Tottori University) Ando, Takayuki (Center for International Affairs, Tottori University) Tsuji, Wataru (Faculty of Agriculture, Tottori University) Inoue, Tomoe (Arid Land Research Center, Tottori University) Sasai, Tomohiro (Graduate School of Engineering, Osaka University) Takemoto, Takahiro (Graduate School of Engineering, Osaka University) Sakai, Hiroe (Graduate School of Engineering, Osaka University) Mohammed Ahmed (Graduate School of Engineering, Osaka University) Tomemori, Hisashi (Arid Land Research Center, Tottori University) Tsuchimoto, Suguru (Graduate School of Engineering, Osaka University)	
共同研究要旨 Summary of Joint Research	<p>We held the 7 th International Symposium “Effective Use of Bioresources in Arid Land” at Faculty of Engineering, Osaka University (Suita city, Osaka) on March 18 th and 19 th. It is the international symposium aiming to have a prospect for the future of bioresource usage in arid lands, mainly by exchanging information and discussing about research of drought-tolerant biofuel crop jatropha and drought-tolerant oil crop jojoba as well. We invited Prof. Seif Gasim from the University of Khartoum, Sudan, who talked about the jojoba cultivation in Sudan, including the past background from 1970 th, and the future. Other 13 papers were from Japan and also actively discussed. Among them, 7 papers were presented by members of “jatropha workshop” (see “Achievements”). They were about cultivation, transgenic plants, metabolites analysis, mycorrhizal fungi, and nondestructive seed oil analysis of jatropha and jojoba, as well as about related topics, which were utilization of transcriptional factors to create stress-tolerant transgenic plants and parasitic plants that are big problems in the arid land agriculture. Number of participants was 27. Participants of Japanese institutes were from Tottori University, Osaka University, AIST, Osaka Prefecture University, Nagoya University, Kinki University, Kobe University, Teikyo University of Science, Japan International Research Center for Agricultural Sciences, and Osaka College of High Technology.</p>	

## 1.4 国内外との交流

### (1) 国際共同研究

#### 乾燥地災害学の体系化

期間：2013年5月～2018年3月

代表者：篠田雅人、鳥取大学

組織：鳥取大学乾燥地研究センター・モンゴル気象水文環境研究所・オックスフォード大学・ケルン大学

研究費：科研費基盤研究 (S)

課題：本研究はユーラシア内陸部にある乾燥地特有の4種類の災害を発生機構と時間スケールから関係づけ、それらへの対応を体系化することを目的とする。最近の気候変動研究によると、将来には世界各地で極端な気象の増加が予測されている。これらは、外的インパクトとして4D災害(干ばつ Drought、寒雪害 Dzud、砂塵嵐 Dust storm、砂漠化 Desertification)を頻発させる可能性があるため、4D災害の発生機構を気候メモリという視点から統合的に理解し、それらの影響を災害のリスク=外的インパクトの規模×乾燥地自然-社会システムの脆弱性(暴露、感受性、復元力で構成)という新しい枠組みでとらえる。さらに、地理、環境動態、保健医学、社会経済など多分野が協同し、データ収集・解析、衛星観測、モデリングなどの手法により、4D災害のリスクを統合的に評価し、能動的対応を提言する。

#### モンゴルの野生哺乳類大移動の保全：新規鉄道建設前の実態把握と建設後の影響評価

期間：2012年4月～2015年3月

代表者：伊藤健彦、鳥取大学

組織：鳥取大学乾燥地研究センター(伊藤健彦)・モンゴル科学アカデミー生物学研究所(B. Lhagvasuren)

研究費：科学研究費補助金

課題：モンゴル南部では大規模鉱山開発に伴う新規鉄道・道路建設が進行中であり、長距離移動をおこなう野生有蹄類への影響が懸念されている。鉄道建設前の現時点での野生動物の移動や生息地選択の実態を衛星追跡や環境のリモートセンシング等から明らかにし、鉄道建設後の影響を評価することを目的としている。

#### 根寄生雑草ストライガの宿主養水分収奪戦略におけるアブシジン酸の重要性の解明

期間：2011年4月～2014年3月

代表者：井上知恵、鳥取大学

組織：鳥取大学乾燥地研究センター(井上知恵)

研究費：科学研究費補助金 若手 (B)

課題：根寄生雑草ストライガの宿主により、宿主作物ではアブシジン酸濃度が増加し、気孔が閉じる。本研究では、ストライガと宿主作物ソルガムにおけるアブシジン酸生産とその分配について調査を行っている。

#### 持続的食糧生産のためのコムギ育種素材開発プロジェクト

期間：2011年4月～2016年3月

代表者：坂智広、横浜市立大学

組織：横浜市立大学(坂智広)・鳥取大学乾燥地研究センター(辻本壽、アミン・エリタエブ)・理研(松井南)・JICAアフガニスタン事務所(M. Osmanzai)

研究費：JST・JICA

## 1.4 Exchange Programs

### (1) International Joint Research

#### Integrating Dryland Disaster Science

Period: May 2013–March 2018

Leader: M. Shinoda, Tottori University

Organization: ALRC Tottori University, IMHE of Mongolia, Oxford University, Cologne University

Funding: Grants-in-Aid for Scientific Research program supported by the Japan Society for the Promotion of Science

Subject: The present project's dual aims include (1) relating the 4D disasters in the Eurasian dry inland area to each other in terms of causal mechanisms (especially drought memory) and the time scales of their occurrence, and (2) developing comprehensive proactive countermeasures and making policy recommendations designed to mitigate multi-disaster impacts.

#### Conservation of great migration of wild mammals in Mongolia: monitoring of current conditions and assessment of new railroad construction

Period: Apr. 2012–Mar. 2015

Leader: T. Ito, Tottori University

Organization: ALRC, Tottori University (T. Ito) and Institute of Biology, Mongolian Academy of Sciences (B. Lhagvasuren)

Funding: JSPS Grants-in-Aid for Scientific Research

Subject: Influence by construction of new railroad and roads to permit big mining project in south Mongolia on wild mammals moving long distances is concerned. This project aims to monitor current situation of movements and habitat selection of wild mammals by using satellite tracking and remote sensing etc. and to assess influences after the railroad construction.

#### Role of abscisic acid in water and solute uptake from the host by the root parasitic weed *Striga hermonthica*

Period: Apr. 2013–Mar. 2016

Leader: T. Inoue, Tottori University

Organization: ALRC, Tottori University (T. Inoue)

Funding: JSPS Grant-in-Aid for Scientific Research

Subject: *Striga hermonthica* parasitizes root of gramineous plants. *S. hermonthica*-infection increases abscisic acid (ABA) concentration, and hence causes stomata closure in the host plants. In this study, I have studied on ABA production and its translocation between the host sorghum and *S. hermonthica*.

#### Project for the development of wheat breeding materials for sustainable food production

Period: Apr. 2011–Mar. 2016

Leader: T. Ban, Yokohama City University

Organization: Yokohama City University (T. Ban), ALRC Tottori University (H. Tsujimoto, A.E. Eltayeb), Riken (M. Matsui) and JICA Afghanistan Office (M. Osmanzai)

Funding: JST and JICA

Subject: The aim of this project is development of wheat breeding system for sustainable food production in Afghanistan to conserve the local varieties and wild relatives of wheat maximizing their potential as breeding materials for high yield and good quality. In this project we produced a

課題：この研究の目的はアフガニスタンのコムギの地方品種と近縁野生植物の収量および品質に関する育種において可能性を最大限発掘することにより、それらを保全することである。本研究において、私達は野生植物タルホコムギの多様性を包含するアフガニスタンの地方品種「Sephadak Ishkashim」集団を育成した。この集団をアフガニスタンの試験場で栽培し、ストレス耐性について選抜する予定である。

**エジプトナイル川流域における食料・燃料の持続的生産**  
期間：2009年4月～2015年3月

代表者：佐藤政良、筑波大学

組織：カイロ大学・エジプト農業研究所・エジプト水研究所・筑波大学・鳥取大学

研究費：国際協力事業団（JICA）および科学技術振興機構（JST）

課題：ナイル川に頼る乾燥地エジプトでは急激な人口増加が進み、食糧増産と雇用拡大が緊急課題となっている。だが主要な農業地域であるナイルデルタでの生産量は限られ、使えるナイル川の水資源も限界に達した。そこでデルタ地帯の既存農地で水利用の合理化、節水を行い、生み出した水を周辺の沙漠地帯に送って農地開発を進め、食糧生産の拡大を図る必要がある。そのためにデルタでの灌漑用水や農地の効率的・持続的な利用法を構築する。

**乾燥および塩耐性に関係する新規で独自の遺伝子の同定**  
期間：2013年5月～2016年5月

代表者：T. Abdel-Fatah, Qatar University

組織：カタール大学（T. Abdel-Fatah）・鳥取大学乾燥地研究センター（田中浄、辻本壽、アミン・エリタエブ）・イリノイ大学（O. Radwan）

研究費：カタール国立研究基金

課題：カタールの農業は灌漑用水の欠乏、土壌の劣化および不適な機構条件のため大きい問題に直面している。このプロジェクトは、耐乾性の新規遺伝子の同定、解析および有用作物への導入を通じた遺伝子レベルでの研究および、生理的および分子的レベルの両面でストレス適応に関する鍵となる因子を理解することにより、ストレス環境に対抗する方法を改善することを目的としている。

**根寄生雑草克服によるスーダン乾燥地農業開発**

期間：2009年6月～2015年3月

代表者：杉本幸裕、神戸大学

組織：神戸大学（杉本幸裕・山内靖雄・鯨島啓彰）・スーダン科学技術大学（A.G.T. Babiker, A.H.E. Hamad）・鳥取大学乾燥地研究センター（井上知恵）等

研究費：地球規模課題対応国際科学技術協力事業経費

課題：根寄生植物ストライガ（*Striga hermonthica*）は、ソルガムやパールミレットなどのイネ科の主要作物に寄生することから、アフリカの乾燥地で主要作物の収量低下の最も大きな生物学的要因となっている。本プロジェクトで、井上は小課題“宿主養水分収奪機構の解析”を担当し、土壌乾燥条件下でのストライガと宿主ソルガムの光合成特性や気孔応答について共同研究を行っている。

population of Afghanistan landrace, Sephadak Ishkashim, holding the diversity of wheat related wild species, *Ae. tauschii*. The population is cultivated in the experimental field of Afghanistan and will be selected for stress tolerance.

**Sustainable systems for food and bio-energy production under water-saving irrigation in the Egyptian Nile basin**

Period: April 2009–March 2015

Leader: Masayoshi Satoh, University of Tsukuba

Organization: Cairo University, Agricultural Research Center of Egypt, National Water Research Center of Egypt, University of Tsukuba, Tottori University

Funding: Japan International Cooperation Agency and Japan Science and Technology Agency

Subject: To meet increasing water demand, more efficient use of water is required in Egypt. The goals of this project are to present methods for more efficient and sustainable use of water and policy to implement or promote them

**Isolation of new and unique genes related to drought and salinity tolerance**

Period: May 2013–May 2016

Leader: T. Abdel-Fatah, Qatar University

Organization: Qatar University (T. Abdel-Fatah), ALRC Tottori University (K. Tanaka, H. Tsujimoto, A.E. Eltayeb) and University of Illinois (O. Radwan)

Funding: Qatar National Research Fund

Subject: Agriculture in Qatar faces great challenges due to the scarcity of irrigation water, the poor quality of the soils, and adverse climatic conditions. This project aims to identify and improve strategies to cope with stressful environments at the gene levels through the discovery, characterization and integration of new genes for drought tolerance into useful food crops as well as understanding the key factors in stress adaptation at both the physiological and molecular levels.

**Improvement of food security in semi-arid regions of Sudan through management of root parasitic weeds**

Period: Jun. 2009–Mar. 2015

Leader: Y. Sugimoto, Kobe University

Organization: Kobe University (Y. Sugimoto, Y. Yamauchi, H. Samejima), Sudan University of Science and Technology (A.G.T. Babiker A.H.E. Hamad) and ALRC, Tottori University (T. Inoue) et al.

Funding: JICA-JST SATREPS

Subject: Root hemi-parasite *Striga hermonthica* parasitizes gramineous plants, including sorghum and pearl millet, so that the most serious biotic constraint on crop production in the dry areas of Africa. In this project, I have conducted joint research on photosynthetic capacity and stomatal responses in *S. hermonthica* and host sorghum under different water regimes.

## (2) 海外出張・研修 / Researchers' Travels Abroad

氏名 Name	国名 Country	期間 Period	用務内容 Purpose	経費 Fund
篠田 雅人 Shinoda, Masato	ロシア Russia	May. 10-22, 2013	黄砂プロジェクトに関わる基礎資料の収集 Research on Project Asian Dust	黄砂プロジェクト Project Asian Dust
	モンゴル Mongolia	Jun. 9-15, 2013	「東アジア砂漠化における黄砂の発生源対策と人間・環境への影響評価」実施に係る調査およびフェンス設置 Research on "Assessment and Control of Dust Emission in Degraded Dryland of East Asia"	黄砂プロジェクト Project Asian Dust
	モンゴル Mongolia	Jul. 26- Aug. 31, 2013	「乾燥地災害学の体系化」に関する現地調査 Field survey on "Integrating dryland disaster sciencesand"	科学研究費補助金 JSPS Grant-in-Aid for Scientific Research
	中国 China	Sep. 22-28, 2013	気候変動による甚大な影響についての IUTAM 国際会議に参加 Participation on IUTAM Symposium on the dynamics of extreme events influenced by climate change	蘭州大学 Lanzhou University
	カナダ Canada	Nov. 16- Dec. 3, 2013	「乾燥地災害学の体系化」に関する研究打合せ Research meeting on "Integrating dryland disaster sciencesand"	科学研究費補助金 JSPS Grant-in-Aid for Scientific Research
	中国 China	Dec. 9-15, 2013	蘭州ワークショップに参加 Participation on the Workshop of Lanzhou University	卓越大学院補助金 MEXT Grants for Formation of the Outstanding Hub Graduate schools
	ドイツ Germany	Mar. 19-27, 2014	研究打合せ Research meeting	ケルン大学 University of Cologne
安田 裕 Yasuda, Hiroshi	スーダン Sudan	Jun. 25- Jul. 1, 2013	乾燥地における地下水水文系と植生の関係に関する調査 Field survey on interaction between subsurface hydrology and plants in arid environment	科学研究費補助金 JSPS Grant-in-Aid for Scientific Research
	スウェーデン 王国 Sweden	Sep. 1-9, 2013	乾燥環境下での非均一土壌中の移動現象についての共同研究 Cooperation study on transport phenomena in heterogeneous soil in arid land	私費 Private fund
黒崎 泰典 Kurosaki, Yasunori	モンゴル Mongolia	Apr. 14-23, 2013	黄砂発生メカニズム解明のための観測機器設置および集中観測開始 An installation of observation devices for elucidation of dust emission mechanisms and starting an intensive observation	黄砂プロジェクト Project Asian Dust
	モンゴル Mongolia	May 26- Jun. 5, 2013	黄砂発生集中観測およびその撤収作業 An intensive observation for elucidation of dust emission mechanisms and its closing	黄砂プロジェクト Project Asian Dust
	モンゴル Mongolia	Aug. 20-30, 2013	黄砂観測サイトにおける 10 m タワー設置、鳥取大学理事視察案内及び現地調査 An installations of 10-m height tower, a guidance of visit of a Tottori University administration officer, and a survey in the dust observation site	黄砂プロジェクト Project Asian Dust 科学研究費補助金 JSPS Grant-in-Aid for Scientific Research
	モンゴル Mongolia	Mar. 9-22, 2014	黄砂発生メカニズム解明のための機器メンテナンスおよび観測 A maintenance of devices and an observation for elucidation of dust emission mechanisms	黄砂プロジェクト Project Asian Dust

氏名 Name	国名 Country	期間 Period	用務内容 Purpose	経費 Fund
恒川 篤史 Tsunekawa, Atsushi	ドイツ Germany	Apr. 9-12, 2013	砂漠化対処条約科学技術委員会第3回特別会合 に出席 Participation in the Third special session of the Committee on Science and Technology of the UNCCD	環境省 The Ministry of the Environ- ment
	イスラエル/ ヨルダン Israel / Jordan	May 7-18, 2013	パレスチナおよび周辺国における乾燥地農業分 野の協力可能性検討にかかる業務出張 Official trip to examine the possibility of collabo- ration in the field of dry farming in Palestine and its neighboring	JICA Japan International Coopera- tion Agency
	中国 China	Aug. 2-4, 2013	The Fourth Kubuqi International Desert Forum に 参加 Participation on the Fourth Kubuqi International Desert Forum	The Fourth Kubuqi Interna- tional Desert Forum
	ナミビア、 南アフリカ Namibia/ South Africa	Sep. 14-28, 2013	ナミビアにおける砂漠化対処条約第11回締約 国会議参加及び南アフリカ共和国における研究 打合せ Participation in the 11 <sup>th</sup> COP of UNCCD held in Namibia and research meeting in South Africa	地球人間環境フォーラム The Global Environmental Forum
	中国 China	Oct. 16-19, 2013	研究打合せ Research meeting	運営費交付金 Cooperative Research Pro- gram of ALRC
	中国 China	Oct. 21-27, 2013	MSプログラムコースワーク講師、閉講式出 席、学生交流の打合せ Participation in the course work as a lecturer and the closing ceremony, and meeting on student ex- change under MS Programme	鳥取大学国際交流センター Center for International Af- fairs of TU
	中国 China	Dec. 8-12, 2013	蘭州ワークショップに参加 Participation on the Workshop of Lanzhou Univer- sity	卓越大学院補助金 MEXT Grants for Formation of the Outstanding Hub Graduate School
	エチオピア Ethiopia	Jan. 31- Feb. 9, 2014	国際河川・青ナイル川流域における土壌侵食・ 土壌流亡緩和のための土地管理に関する調査 Field investigation for "Land Management to miti- gate soil erosion and loss in the Blue Nile basin"	科学研究費補助金 JSPS Grant-in-Aid for Scien- tific Research
	メキシコ Mexico	Mar. 6-11, 2014	研究打合せ Research meeting	ポスト GCOE プログラム Post Global COE Program
辻本 壽 Tsujimoto, Hisashi	韓国 South Korea	Apr. 15-21, 2013	第3回 Genomics of Plant Genetic Resources に参 加 Participation in the 3 <sup>rd</sup> Genomics of Plant Genetic Resources	横浜市立大学 Yokohama City University
	中国 China	Jun. 6-15, 2013	共同研究打合せ、第7回国際ムギ類シンポジウ ムに参加 Participate in the 7 <sup>th</sup> International Triticeae Sympo- sium	科学研究費補助金 JSPS Grant-in-Aid for Scien- tific Research
	トルコ Turkey	Jun. 15-24, 2013	Participation in Japan-Turkey-Afghanistan collabo- ration Workshop "Wheat germplasm collection and utilization for re-establishing wheat breeding system in Afghanistan"	横浜市立大学 Yokohama City University



氏名 Name	国名 Country	期間 Period	用務内容 Purpose	経費 Fund
辻本 壽 Tsujimoto, Hisashi	アメリカ United States of America	Jul. 17-19, 2013	WGRC Alumni Symposiumに参加 Participation in WGRC Alumni Symposium	運営費交付金 Cooperative Research Program of ALRC
	キルギス共和国 Kyrgyz Republic	Jul. 19- Aug. 5, 2013	東アジアにおける有用植物遺伝資源研究拠点の構築にかかるムギ類植物遺伝資源の学術調査 Participate in the academic investigation of wheat and barley germplasm to establish COE on useful plant genetic resources in the Eastern Asia	岡山大学 Okayama University
	イスラエル Israel	Aug. 23-28, 2013	ポスト GCOE プロジェクトに係る研究調査 Research on Post Global COE Program	ポスト GCOE プログラム Post Global COE Program
	中国 China	Dec. 9-15, 2013	蘭州ワークショップに参加 Participation in the Workshop of Lanzhou University	卓越大学院補助金 MEXT Grants for Formation of the Outstanding Hub Graduate schools
	ノルウェー Kingdom of Norway	Feb. 21-26, 2014	東アジアに渡来・起源した作物資源の遺伝的評価と開発的研究にかかるムギ類植物遺伝資源の研究打合せおよび学術調査 Participate in academic meeting on genetic evaluation and developmental research about crop resources originating and transferred from the East Asia	岡山大学 Okayama University
	スーダン/ モロッコ Sudan / Kingdom of Morocco	Feb. 26- Mar. 8, 2014	耐暑性コムギの選抜および耐乾性コムギの選抜 Selection of heat and drought tolerant wheat plants	科学研究費補助金 JSPS Grant-in-Aid for Scientific Research
メキシコ Mexico	Mar. 22-28, 2014	BGRI Technical Workshop 2014 および Borlaug Summit on Wheat for Food Security に参加 Participation on BGRI Technical Workshop 2014 and Borlaug Summit on Wheat for Food Security	横浜市立大学 Yokohama City University	
安 萍 An, Ping	中国 China	Oct. 11-23, 2013	国際ワークショップ(塩性土壌と塩生植物利用)に参加 Participate on the International Workshop on Mechanisms of Plant Stress Tolerance and Sustainable Use of Saline Resources	中国科学院遺伝/発育生物学研究所農業資源センター CAR / CAS
	中国 China	Dec. 8-15, 2013	蘭州ワークショップに参加 Participate on the Workshop of Lanzhou University	卓越大学院補助金 MEXT Grants for Formation of the Outstanding Hub Graduate schools
エリタイブ ハボラ E. アミン Eltayeb Habora, E. Amin	オーストラリア Australia	Aug. 31- Sep. 8, 2013	国際学会 (INTERDROUGHT-IV) に出席 Participation on the Interdrought -IV	運営費交付金 Cooperative Research Program of ALRC
	スーダン Sudan	Feb. 22- Mar. 10, 2014	共同研究に関する調査および研究打合せ Research and research meeting for the joint research	運営費交付金 Cooperative Research Program of ALRC
	メキシコ Mexico	Mar. 19-31, 2014	BGRI 2014 Technical Workshop に参加 Participation on the BGRI 2014 Technical Workshop	運営費交付金 Cooperative Research Program of ALRC

氏名 Name	国名 Country	期間 Period	用務内容 Purpose	経費 Fund
山中 典和 Yamanaka, Norikazu	中国 China	May 7-12, 2013	黄砂プロジェクト推進のための現地調査及び打ち合わせ Research on the Project Asian Dust and field survey	黄砂プロジェクト Project Asian Dust
	モンゴル Mongolia	May 27- Jun. 4, 2013	黄砂プロジェクト推進のための現地調査 Research on the Project Asian Dust and field survey	黄砂プロジェクト Project Asian Dust
	モンゴル Mongolia	Jul. 14-21, 2013	黄砂プロジェクト推進のための現地調査 Research on the Project Asian Dust and field survey	黄砂プロジェクト Project Asian Dust
	モンゴル Mongolia	Aug. 2-14, 2013	乾燥地生態系の構造と機能および空間分布についての解析のための現地での生態群落調査 Research on the structure, function and spatial distribution of dryland ecosystems	環境省環境研究総合推進費 The Environment Research and Technology Development fund, Ministry of the Environment
	モンゴル Mongolia	Aug. 24- Sep. 8, 2013	黄砂プロジェクト推進のための現地調査 Research on the Project Asian Dust and field survey	黄砂プロジェクト Project Asian Dust
	アラブ首長国連邦 United Arab Emirates	Oct. 4-14, 2013	黄砂プロジェクト推進のための調査 Research on the Project Asian Dust	黄砂プロジェクト Project Asian Dust
	中国 China	Oct. 17-19, 2013	黄砂プロジェクト推進のための打ち合わせ Research meeting for the Project Asian Dust	黄砂プロジェクト Project Asian Dust
	中国 China	Oct. 29-31, 2013	黄砂問題調査検討業務にかかるワーキンググループ2（発生源対策）会合へ出席 Participation on the Japan-China-Korea DSS WG II meeting	環境省 The Ministry of Environment
	韓国 South Korea	Nov. 4-8, 2013	二国間交流セミナー出席 Participation on the Japan -Korea Joint Seminar	日本学術振興会 Japan Society for the Promotion of Science
	中国 China	Dec. 9-13, 2013	蘭州ワークショップに参加するため Participation on the Workshop at Lanzhou, China	卓越大学院補助金 MEXT Grants for Formation of the Outstanding Hub Graduate schools
スーダン Sudan	Mar. 1-13, 2013	黄砂プロジェクトに係わる現地調査及び打ち合わせ Research on the Project Asian Dust and field survey	黄砂プロジェクト Project Asian Dust	
藤巻 晴行 Fujimaki, Haruyuki	エジプト Egypt	Apr. 14-26, 2013	「ナイル川流域における食糧・燃料の持続的生産プロジェクト」の研究打合せおよび現地作業 Research activities on "Sustainable systems for food and bio-energy production with water-saving irrigation in the Egyptian Nile basin"	国際協力機構 Japan International Cooperation Agency
	イスラエル/ ヨルダン Israel/ Jordan	May 7-17, 2013	パレスチナおよび周辺国における喧騒地農業分野の協力可能性検討にかかる業務出張 Official trip to examine the possibility of collaboration in the field of dry farming in Palestine and its neighboring	国際協力機構 Japan International Cooperation Agency

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藤巻 晴行 Fujimaki, Haruyuki	エジプト Egypt	May 17-26, 2013	「ナイル川流域における食糧・燃料の持続的生 産プロジェクト」の研究打合せおよび現地作業 Research activities on “Sustainable systems for food and bio-energy production with water-saving irrigation in the Egyptian Nile basin”	国際協力機構 Japan International Coopera- tion Agency
	エジプト Egypt	Jun. 2-5, 2013	灌漑管理統合評価指標の開発に係る現地調査 Field survey on integrated performance assessment indices of irrigation management	科学研究費補助金 JSPS Grant-in-Aid for Scien- tific Research
	エジプト Egypt	Jun. 6-9, 2013	「ナイル川流域における食糧・燃料の持続的生 産プロジェクト」の研究打合せおよび現地作業 Research activities on “Sustainable systems for food and bio-energy production with water-saving irrigation in the Egyptian Nile basin”	国際協力機構 Japan International Coopera- tion Agency
	ラオス Lao People's Democratic Republic	Jul. 6-14, 2013	ラオス国水田土壌の土壌水分特性の把握 Investigation on hydraulic properties of paddly soil of Lao	国際農林水産業研究セン ター The Japan International Re- search Center for Agricul- tural Sciences
	イスラエル Israel	Aug. 23-31, 2013	ポスト GCOE プロジェクトに係る研究調査 Research on Post Global COE Project	ポスト GCOE プロジェク ト Post Global COE Project
	ラオス Lao People's Democratic Republic	Nov. 22-28, 2013	ラオス国水田土壌の土壌水分特性の把握 Investigation on hydraulic properties of paddly soil of Lao	国際農林水産業研究セン ター The Japan International Re- search Center for Agricul- tural Sciences
	中国 China	Dec. 9-15, 2013	蘭州ワークショップに参加 Participation on the Workshop of Lanzhou Univer- sity	卓越大学院補助金 MEXT Grants for Formation of the Outstanding Hub Graduate Schools
	エジプト Egypt	Feb. 6-12, 2014	「ナイル川流域における食糧・燃料の持続的生 産プロジェクト」の研究打合せおよび現地作業 Research activities on “Sustainable systems for food and bio-energy production with water-saving irrigation in the Egyptian Nile basin”	国際協力機構 Japan International Coopera- tion Agency
	ラオス Lao People's Democratic Republic	Feb. 17-23, 2014	ラオス国水田土壌の土壌水分特性の把握 Investigation on hydraulic properties of paddly soil of Lao	国際農林水産業研究セン ター The Japan International Re- search Center for Agricul- tural Sciences
エジプト Egypt	Mar. 19-29, 2014	「ナイル川流域における食糧・燃料の持続的生 産プロジェクト」の研究打合せおよび現地作業 Research activities on “Sustainable systems for food and bio-energy production with water-saving irrigation in the Egyptian Nile basin”	国際協力機構 Japan International Coopera- tion Agency	
伊藤 健彦 Ito, Takehiko	イギリス United King- dom	Aug. 8-25, 2013	第 11 回国際哺乳類学会、国際生態学会 2013 年 大会参加 Participation on the 11th International Mam- malogical Congress and the 11th International Congress of Ecology (INTECOL 2013)	運営費交付金 Cooperative Research Pro- gram of ALRC

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伊藤 健彦 Ito, Takehiko	モンゴル Mongolia	Sep. 18-30, 2013	「モンゴルの野生哺乳類大移動の保全」に係る現地調査および研究打合せ Field survey and meetings on conservation of great migration of wild mammals in Mongolia	科学研究費補助金 JSPS Grant-in-Aid for Scientific Research
谷口 武士 Taniguchi, Takeshi	中国 China	May 5-12, 2013	黄砂プロジェクト推進の為の現地調査及び打ち合わせ Discussion and field survey for the Project Asian Dust	黄砂プロジェクト Project Asian Dust
	アメリカ合衆国 United State of America	Jun. 12-30, 2013	乾燥ストレス条件下における植物の生存戦略と微生物共生特性の解明に係わる現地調査及び打ち合わせ Discussion and field survey concerning the characteristics of the survival strategy and symbiotic microorganisms of plants under drought stress	科学研究費補助金 JSPS Grant-in-Aid for Scientific Research
	中国 China	Aug. 17-30, 2013	黄砂プロジェクト推進のための現地調査 Field survey on the Project Asian Dust	黄砂プロジェクト Project Asian Dust
	アメリカ合衆国 United States of America	Sep. 9-22, 2013	乾燥ストレス条件下における植物の生存戦略と微生物共生特性の解明に係わる言質調査及び打ち合わせ Discussion and field survey concerning the characteristics of the survival strategy and symbiotic microorganisms of plants under drought stress	科学研究費補助金 JSPS Grant-in-Aid for Scientific Researcher
	スーダン Sudan	Mar. 1-13, 2014	黄砂プロジェクトに係わる現地調査及び打ち合わせ Discussion and field survey for the Project Asian Dust	黄砂プロジェクト Project Asian Dust
	鍋田 肇 Nabeta, Hajime	パレスチナ/ イスラエル Palestine/ Israel	Aug. 23-30, 2013	パレスチナ国立農業研究所 (NARC) 及びナジャハ大学農獣医学部との共同研究の可能性に関する調査 Seminar on technical cooperation in the Palestinian dry-lands, and meeting with JICA Tel Aviv Office on possible future collaborations
ナミビア Namibia		Sep. 14-20, 2013	UNCCD COP 11 (国連砂漠化対処条約・第11回締約国会議) のブース出展参加 Exhibitor, COP-11 of United Nations Conference to Combat Desertification (UNCCD)	運営費交付金 Cooperative Research Program of ALRC
メキシコ Mexico		Nov. 6-16, 2013	メキシコ海外実践教育プログラムフィールドワーク担当教員 Overseas Practical Education Program Tottori-CIBNOR-UABCS 2013	鳥取大学国際交流センター Center for International Affairs of TU
ヨルダン/ パレスチナ/ イスラエル Jordan/ Palestine/ Israel		Mar. 19-26, 2014	パレスチナ及び周辺国における乾燥地農業分野の協力可能性調査 JICA Mission on Agriculture Projects in Jordan and Palestine	国際協力機構 Japan International Cooperation Agency
岡本 昌憲 Okamoto, Masanori	中国 China	Jun. 18-23, 2013	国際学会に参加 Participation on Conference of the International Plant Growth Substances Association	テニュアトラック補助金 JST Tenure-Track Award
Tsegaye, Enyew Adgo	エチオピア Ethiopia	Apr. 1-15, 2013	研究打合せおよび現地調査 Research meeting and field survey	運営費交付金 Cooperative Research Program of ALRC

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Panda, Sudhindra Nath	インド India	Dec. 12-28, 2013	第6回国際会議（ICER-13）出席およびインド工科大学での研究打合せ Participation on 6 <sup>th</sup> International Congress of Environmental Research and research meeting at IIT	運営費交付金 Cooperative Research Program of ALRC
Banzragchi, Nandintsetseg	ドイツ Germany	Mar. 18-24, 2014	黄砂プロジェクトに係る研究打ち合わせ Research meeting about Project Asian Dust	運営費交付金 Cooperative Research Program of ALRC
Mohamed Ahmed Ali, Isam Ali	中国 China	Nov. 29- Dec. 6, 2013	バイオテクノロジートレーニングコースの受講 Attend a biotechnology training course	運営費交付金 Cooperative Research Program of ALRC
	スーダン Sudan	Feb. 20- Mar. 16, 2014	現地視察及び研究打ち合わせ Field survey and research meeting	運営費交付金 Cooperative Research Program of ALRC
留森 寿士 Tomemori, Hisashi	メキシコ Mexico	Oct. 7-16, 2013	ジャトロファ研究に関する調査、打合せおよび情報収集 Research, research meeting and correct data for study of Physic nut	運営費交付金 Cooperative Research Program of ALRC
	メキシコ Mexico	Mar. 6-10, 2014	研究打合せ Research meeting	運営費交付金 Cooperative Research Program of ALRC
井上 知恵 Inoue, Tomoe	スーダン Sudan	Jul. 20-28, 2013	スーダン科学技術大学で根寄生雑草ストライガに関する共同研究の実施 Conducting joint research on root parasitic weed <i>Striga hermonthica</i> with scientists at the Sudan University of Science and Technology	JICA-JST SATREPS 事業経費 JICA-JST SATREPS
	スーダン Sudan	Sep. 7-28, 2013	スーダン科学技術大学で根寄生雑草ストライガに関する共同研究の実施 Conducting joint research on root parasitic weed <i>Striga hermonthica</i> with scientists at the Sudan University of Science and Technology	科学研究費補助金 JSPS Grant-in-Aid for Scientific Research
Meshesha, Derege Tsegaye	エチオピア Ethiopia	Jan. 31- Feb. 26, 2014	国際河川・青ナイル川流域における土壌侵食・土壌流亡緩和のための土地管理に関する調査 Field investigation for "Land Management to mitigate soil erosion and loss in the Blue Nile basin"	科学研究費補助金 JSPS Grant-in-Aid for Scientific Research
Bat-Oyun, Tserenpurev	モンゴル Mongolia	May 31- Oct. 15, 2013	モンゴルの伝統食「馬乳酒」製造に関する伝統的知識の科学的検証と応用に関する研究 Research on Integration of Traditional and Scientific Knowledge for Promoting Fermented Mare Milk (Airag: in Mongolia) Production	科学研究費補助金 JSPS Grant-in-Aid for Scientific Research
	モンゴル Mongolia	Mar. 7-18, 2014	AWSのデータ収集、データ分析、資料収集および研究打合せ Correct and analyze AWS data and research meeting	科学研究費補助金 JSPS Grant-in-Aid for Scientific Research
徳本 家康 Tokumoto, Ieyashu	アメリカ合衆国 United States of America	Aug. 2-8, 2013	トウモロコシ畑の調査および実験データの取得及び温室効果ガスに関する研究打ち合わせ Meeting and survey for green gas emissions from a corn field in College Station, TX	運営費交付金 Cooperative Research Program of ALRC
	中国 China	Sep. 22-26, 2013	第3回国際農業学会における招待講演 Keynote speaker at BIT's 3 <sup>rd</sup> World Congress of Agriculture	運営費交付金 Cooperative Research Program of ALRC

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徳本 家康 Tokumoto, Ieyashu	アメリカ合衆国 United States of America	Oct. 23- Nov. 26, 2013	米国土壌科学学会、砂漠技術会議への学会参加 および温室効果ガス発生に関する共同研究の打 ち合わせ Presentation at Annual meeting for Soil Science Society of America in FL & Conference of Desert Technology in TX & Meetings of greenhouse gas emissions at Texas A&M University	科学研究費補助金 JSPS Grant-in-Aid for Scien- tific Research
阿不力提甫 阿不来提 Abulitipu, Abulaiti	モンゴル Mongolia	Apr. 14-23, 2013	黄砂発生メカニズム解明のための観測および観 測機器設置 Research and set the observation aircraft for eluci- dation of dust emission mechanisms	黄砂プロジェクト Project Asian Dust
Aychu, Nigussie Hare- geweyn	エチオピア Ethiopia	Apr. 13-27, 2013	AFRICA 2013 International Conference and Exhi- bition に参加 Participation at AFRICA 2013 International Con- ference and Exhibition	科学研究費補助金 JSPS Grant-in-Aid for Scien- tific Research
	オーストラリ ア Australia	Jun. 22-30, 2013	Asia Oceania Geosciences Society Annual Meeting に参加 Participation at Asia Oceania Geosciences Society Annual Meeting	科学研究費補助金 JSPS Grant-in-Aid for Scien- tific Research
	エチオピア Ethiopia	Jan. 31- Feb. 13, 2014	ポートフォリオ型気候変動適応・緩和方策とし ての流域管理の提案に関する調査 Research on "Proposing watershed management as a portfolio climate change adaptation and mitiga- tion measure"	科学研究費補助金 JSPS Grant-in-Aid for Scien- tific Research

(3) 研究者・受託研究員・研究生の受入れ

研究者

Nasrein Mohamed Kamal Omer

(平成 25 年 4 月 1 日～平成 26 年 3 月 31 日)

スーダン農業研究機構バイオテクノロジー・バイオセーフティー研究センター・研究員

私費

王 涛

(平成 25 年 6 月 16 日～平成 25 年 6 月 30 日)

中国科学院蘭州分院・院長

鳥取大学乾燥地研究センター経費

陳 麗娜

(平成 25 年 7 月 22 日～25 年 10 月 14 日)

河北科技師範学院・講師

河北科技師範学院経費

受託研究員

JICA 集団研修 2013 「乾燥地における持続的農業のための土地・水資源の適正管理」(平成 25 年 8 月 26 日)

Sabery, Mohd Saber (アフガニスタン)、Sekhane, Mohamed (アルジェリア)、Akongo, Emile (カメルーン)、Aboelsou, D Mohamed Hesham (エジプト)、Gobezayehu, Tefera Seifu (エチオピア)、Al-Taie, Yasir Adnan (イラク)、Onwudiachi, Uche Augustina (ナイジェリア)、Boying, Horrison Henry (南スーダン)、Makaka, Florian Pius (タンザニア)、Nyamowa, Joshua (ジンバブエ)、Mwamba, Brenda Lwamba (ザンビア)、Alem, Elsadig Yassen (スーダン)

研究生

Adam Dale Kilpatrick

(平成 25 年 7 月 22 日～平成 26 年 3 月 31 日) オーストラリア

(3) Visiting Researchers, Trainees and Research Students

Visiting Researcher

Nasrein Mohamed Kamal Omer

(Apr. 1, 2013–Mar. 31, 2014)

Researcher, Biotechnology and Biosafety Research Center, Agriculture Research Corporation, Sudan

Private funds

Tao Wang

(Jun. 16, 2013–Jun. 30, 2013)

President, Lanzhou Branch of Chinese Academy of Sciences  
Funded by Arid Land Research Center, Tottori University

Lina Chen

(Jul. 22, 2013–Oct. 14, 2014)

Lecturer, Hebei Normal University of Science and Technology

Funded by Hebei Normal University of Science and Technology

Visiting Trainees

JICA Group Training Course 2013 “Appropriate Management of Land and Water Resource for Sustainable Agriculture in Arid/Semi-arid Regions”

Sabery, Mohd Saber (Afghanistan), Sekhane, Mohamed (Algeria) Akongo, Emile (Cameroon), Aboelsou, D Mohamed Hesham (Egypt), Gobezayehu, Tefera Seifu (Ethiopia), Al-Taie, Yasir Adnan (Iraq), Onwudiachi, Uche Augustina (Nigeria), Boying, Horrison Henry (South Sudan), Makaka, Florian Pius (Tanzania), Nyamowa, Joshua (Zimbabwe), Mwamba, Brenda Lwamba (Zambia), Alem, Elsadig Yassen (Sudan)

Research Students

Adam Dale Kilpatrick

(Jul. 22, 2013–Mar. 31, 2014) Australia