

1. 研究活動（2015年4月～2016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。

乾燥地研究センターでは、文部科学省特別経費事業「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）」を平成23年度から5年間実施した。プロジェクト最終年度の平成27年度には、これまでの本研究成果の集大成として「黄砂 健康・生活環境への影響と対策（鳥取大学乾燥地研究センター監修 黒崎泰典・黒沢洋一・篠田雅人・山中典和編）」を丸善出版より刊行した。

平成27年には、「乾燥地植物資源を活用した天水栽培限界地における作物技術の開発－世界の耕作限界地における持続的開発を目指して－（通称：限界地プロジェクト）」（平成27年度～平成30年度）が文部科学省特別経費事業に採択され、年間降水量300ミリメートル台の降雨依存農業地域で、持続的な生産を可能にする農業技術パッケージの開発に挑戦している。

平成27年5月10日から14日の5日間、ハルツーム大学（スーダン）からアハメド・モハメド・スレイマン学長他2名を招聘し、鳥取大学とハルツーム大学の学術交流協定の更新を行うとともに、国際セミナー及び共同研究打合せを実施した。

平成27年10月12日から23日に、トルコ・アンカラで開催された国連砂漠化対処条約第12回締約国会議（UNCCD/COP12）に、恒川篤史乾燥地研究センター長が政府代表団の一員として参加したほか、教職員4名を現地に派遣し、展示イベント及びサイドイベントを開催した。また、同締約国会議において、乾燥地研究センターに対するオブザーバーの地位の授与が決定され、これにより、本センターはUNCCD/COP公認のCSO（市民社会

1. Research Overview (April 2015–March 2016)

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 Center. 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 further advancement in the world’s dryland sciences, fulfillment of Japan’s obligation to contribute to the United Nations Convention to Combat Desertification, and human resource development in this field.

ALRC had implemented the Project Asian Dust “Assessment and Control of Dust Emission in Degraded Drylands of East Asia,” funded by MEXT, for five years from FY 2011 through FY 2015. To finalize the project, ALRC published “Asian dust – effects on human health and environment, and counter measure.” (supervised by ALRC, edited by Y. Kurosaki, Y. Kurozawa, M. Shinoda and N. Yamanaka) by Maruzen Publishing Co. in FY 2015.

ALRC has started a four-year project “Development of Crop Husbandry Technology in Marginal Rainfed Environment Using Dryland Plant Resources - Toward Sustainable Improvement in Global Marginal Regions,” or “Project Marginal Region Agriculture” for short, in FY 2015, funded by MEXT. The challenge of this project is to make an agricultural package that enables sustainable production of food, oil and forage crops in the regions with about 300 mm annual rainfall.

During May 10 through 14, ALRC invited Prof. Ahmed Mohamed Suliman, Vice Chancellor of University of Khartoum, Sudan, to renew the agreement of academic exchange and cooperation between the universities and hold international seminars and meetings on collaborative research.

ALRC took part in the UNCCD COP12, held in October 2015 in Ankara, Turkey, participating in the exhibition and

団体)となった。

平成27年10月、乾燥地研究センターの岡本昌憲助教が、アブシジン酸の代謝と受容に関する化学遺伝学的研究における業績を高く評価され、植物化学調節学会第50回大会において奨励賞を受賞した。

平成28年1月28日、*Jatropha curcas* L.に関する共同研究を推進するための基盤を確立するため、メキシコ国立農牧林業研究所(INIFAP)と*Jatropha curcas* L.に関する共同研究推進のための個別合意書を締結した。

さらに、平成28年2月16日、共同研究及び遺伝資源保管分野における交流を促進することを目的として、スーダン農業研究機構(ARC)農業植物遺伝資源保管研究センターと協定を締結した。

乾燥地研究センターは、国立研究開発法人科学技術振興機構(JST)が実施した平成27年度「日本・アジア青少年サイエンス交流事業」(さくらサイエンスプラン)の支援を受け、平成28年2月23日から3月3日までの10日間、中国科学院寒区旱区環境工學研究所から若手研究者・学生等10名を招聘して科学技術交流活動を実施した。

平成28年3月、乾燥地研究センターの辻本壽教授が、異種遺伝資源によるコムギ育種技術の開発と応用に関する研究業績を高く評価され、平成27年度日本育種学会賞を受賞した。

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4名、准教授6名、助教3名、特任教授2名、国内客員3名、外国人客員3名が配置されている。また、プロジェクト研究員10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13名(事務職員5名、事務補佐員8名)、技術系には職員12名(技術職員4名、技術補佐員8名)が配置され、研究・教育の支援事務などを担当している。(人数は平成28年1月1日時点)。

共同研究、教育、刊行物

平成27年度における共同利用研究代表者(大学教員など)は74名、指導学生数は30名(博士課程12名、修士課程9名、学部学生3名、研究生6名、うち留学生18名(中国6名、エチオピア4名、スーダン3名、ナイジェリア2名、エジプト1名、タンザニア1名、イラン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27年度は、12月5日～6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、平成21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

holding a side event at the venue. In addition, the COP12 decided to grant observer status to ALRC, and by this, ALRC becomes an accredited civil society organization (CSO) to the UNCCD COP.

In October 2015, ALRC's Tenure-track Assistant Professor Dr. Masanori Okamoto received Young Scientist Award of the Japanese Society for Chemical Regulation of Plants for his highly evaluated research in chemical genetic studies on abscisic acid metabolism and reception.

On January 28, 2016, ALRC entered into an agreement with the National Institute of Forestry, Agricultural and Animal Research (INIFAP), Mexico, to promote joint research on *Jatropha curcas* L.

In addition, on February 16, 2016, ALRC concluded an agreement with the Agricultural Plant Genetic Resources Conservation and Research Center of the Agricultural Research Corporation (ARC), Sudan, to promote collaborative research and exchange in the field of genetic resources conservation.

ALRC carried out an international science and technology exchange activity during February 23 through March 3, 2016, funded by "SAKURA Exchange Program in Science" of Japan Science and Technology Agency (JST), inviting ten students and researchers from the Cold and Arid Regions Environmental and Engineering Research Institute (CAREERI) of the Chinese Academy of Sciences (CAS).

In March 2016, ALRC's Professor Hisashi Tsujimoto was awarded a prize by the Japanese Society of Breeding for his highly evaluated research achievements on development and application of wheat breeding technology using alien genetic resources.

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 FY2012 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 January 1, 2016, four full-time professors, six associate professors, three assistant professors, two specially appointed professors, three visiting national professors and three visiting international researchers were allocated to these research divisions. In addition, ten project researchers and one JSPS research fellow were added to our research teams. Moreover, 13 office staff (five full-time and eight part-time) and 12 technical staff (four full-time and eight part-time) supported ALRC's research and education.

Joint Research, Education, Publication

In FY 2015, 74 joint-use research representatives, mainly from national and private universities, were attached to ALRC. In addition, ALRC had a total of 30 students; 12 Ph.D. students, 9 master's students, 3 undergraduate students, and 6 research students. Of them, 18 students were from overseas; 6 Chinese, 4 Ethiopian, 3 Sudanese, 2 Nigerian, 1 Egyptian, 1 Tanzanian, and 1 Iranian.

ALRC holds the Joint Research Symposium every year. In FY 2015, we held the symposium on December 5 and 6 at

学専攻」を新設し、学部－修士－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、センターの活動を地域で支え、その研究活動と成果を広く情報発信することを通じて地域の発展を図る組織として設立された「とっとり乾地研倶楽部」の支援により、広報誌を年4回発行し、最新の活動状況等を紹介している。

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）が完成した。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。

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27年度の主な活動は以下のとおり。

- 国連砂漠化対処条約第12回締約国会議（UNCCD/COP12）におけるブース展示（平成27年10月12日～10月16日）及び、サイドイベント（限界地プロジェクトの紹介等、共催：ICARDA、参加者約50名、平成27年10月14日）、トルコ・アンカラ
- 研究活動紹介及び一般公開告知に係るパネル展示：平成27年7月28日～8月5日、鳥取大学学生会館
- 一般公開：平成27年8月7日、参加人数156名
- きみもなろう！砂漠博士（小学生向け実験イベント）：平成27年8月7日、参加人数20名



ALRC participated in the exhibition to showcase its activities at UNCCD COP 12, held in Ankara, Turkey

the center. Seminars were often held by internal and external experts.

Concerning education, a course named “Global Arid Land Science” was established in FY2009 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 ALRC’s research and education activities. In addition, ALRC issues a newsletter four times a year to introduce its latest research activities, supported by the “Tottori Kan-chiken Club” that was established by a local business association.

Accommodation Facility

A guest house was built in August 2011, which is available for joint researchers and students who would like to stay in the premises of ALRC 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 during FY 2015.

- Exhibition on ALRC’s research activities (October 12-16, 2015) and side event on the Project Marginal Region Agriculture (October 14, 2015) in collaboration with ICARDA at UNCCD COP12 held in Ankara, Turkey
- Panel exhibition on ALRC’s research activities (July 28-August 5, 2015, Tottori University Student Union building)
- Open House Event (August 7, 2015, ALRC)
- On-site learning program for elementary students “Let’s become a Dr. Desert” (August 7, 2015, ALRC)



ALRC invited students and researchers from CA-REERI through JST’s SAKURA Exchange Program in Science

(2) 研究部門

1) 気候・水資源部門

木村 玲二 (気象学)

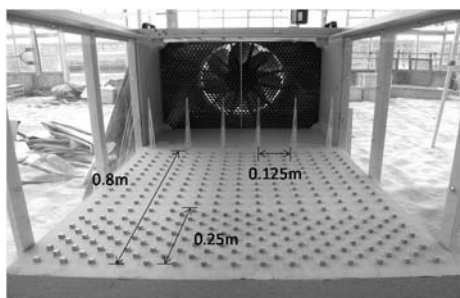
気象学分野では以下のような研究を行っている。

- (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、25220201、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. 積雪の被覆、凍土、地表面の湿潤度、植生の被覆を考慮した東アジア黄砂発生ハザードマップを構築し、セミリアルタイムで更新、インターネット表示できるシステムをパブリック公開した (<http://www.alrc.tottori-u.ac.jp/staff103/thresholdwindspeed/ja.html>)。システムは、衛星データを毎日ダウンロードし、各種演算、データ公開、データアーカイブを行うことが出来、誰でも閲覧可能とした。
2. 「東アジア黄砂発生監視システム」(高次処理データベース検索表示・公開サブシステム) を構築、公開した(現時点では鳥取大学関係者のみ)。本システムは、全球データ自動ダウンロード・アーカイブサブシステムおよび準リアルタイム衛星データ自動ダウンロード処理サブシステムで作成された衛星画像の検索・表示・解析・ダウンロードなどを行うためのシステムである。対象は東アジアだけではなく、全球にまで広げたことに特色がある。プロダクトは、臨界風速、植被率、NDVI、雲マスク、雪マスク、7バンド地表面反射率、SbAI (衛星ベースの乾燥度指数)、凍土マスクである。
3. 飛砂や黄砂発生メカニズム解明のための簡易風洞を設計、作成した。本風洞の特色は、スパイヤーとラフネスブロックを併用し、小型風洞で困難であった境界層を生成できることにある(境界層は 3.6 m の整流距離で 38 cm の厚さ)。さらに、鉛直方向の風速分布を調整し、境界層を生成するだけでなく、水平方向の風速分布を均等に調整することも可能である。本研究は、論文として公表されただけでなく、日本農業気象学会 2016 年全国大会において、ベストポスター賞として評価された。



A small simple type wind tunnel developed by Liu and Kimura (2016).

(2) Research Divisions

1) Climatology and Water Resources Division

Reiji Kimura (Assoc. Prof., Meteorology)

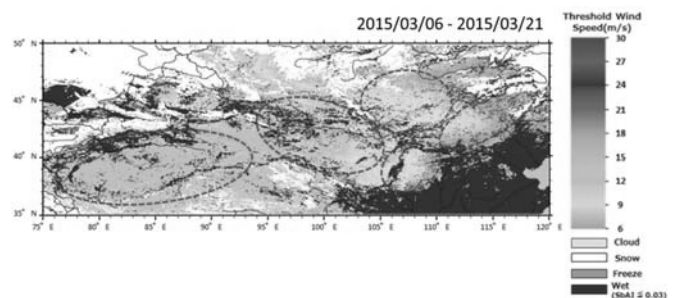
The Meteorology Subdivision conducts research mainly as follows:

- (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, 25220201, 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. To find and monitor dust source regions, a semi-real-time dust erodibility map was developed based on MODIS satellite data that focuses particularly on the threshold wind speed in a target area of northeast Asia including China and Mongolia (35°–50°N, 75°–120°E). The mapping system incorporates satellite data on snow cover, areas of frozen soil, surface soil water content, and vegetation cover.
2. Satellite Image Retrieval and Visualizing Sub-System (SIRVS) is software designed to search, visualize, analyze and download the high-level products produced by the Global Satellite Data, and opened to the public (now is TU only). Products are threshold wind speed, vegetation cover, NDVI, cloud mask, snow mask, reflectivity of 7 bands, SbAI, and soil frozen mask.
3. By the combination use of Speyer and Roughness block, a method for generating a boundary layer in a small wind tunnel was proposed. In the present study, it is not only adjusted to the air velocity distribution in the vertical direction or produced a boundary layer, but also proposed a method of adjusting the air velocity distribution uniformly in the horizontal direction. As a result, the boundary layer is obtained a thickness of 38 cm by 3.6 m rectifying distance. In addition, by devising the arrangement of Roughness block, it has become possible to equalize the air velocity distribution substantially in the horizontal direction.



Hazard map of Asian dust through the web.

Information is updated every day.

(<http://www.alrc.tottori-u.ac.jp/staff103/thresholdwindspeed/ja.html>) (Kimura, 2016)

黒崎 泰典 (ダスト気候学)

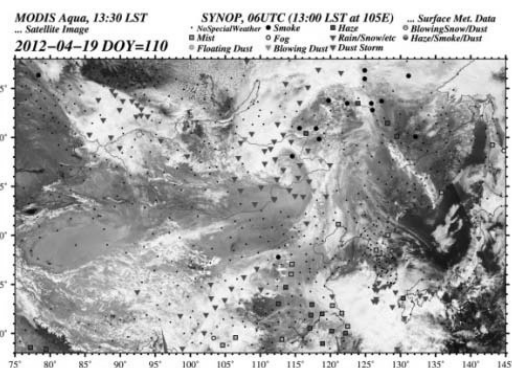
日本では黄砂として知られるダスト粒子(鉱物粒子)は乾燥地や耕作地などにおいて強風によって舞い上がり、より細かい粒子は自由対流圏の風によって長距離輸送される。ゴビ砂漠やタクラマカン砂漠起源のダストはグリーンランド、ハワイ、米国西海岸などにおいてしばしば観測される。ダストは人間生活に大きく影響しているが、発生域と風下域で影響タイプが異なる。発生域では気象災害の側面が強く、人や家畜の死亡・行方不明、建築物損壊などの被害が報告されている。発生域から遠くなるに従い、健康影響、酸性雨中和、海洋生態系への影響、放射過程・雲凝結過程を介した気候への影響といった環境影響の側面が強くなる。ダスト気候学分野では、主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

課題(1)では、気象台データとMODIS衛星画像を用いた東アジア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、ダスト発生・輸送経路の議論に用いた。

課題(2)では、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。これまでの観測から、観測地点周辺約10kmスケールで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、場所による黄砂発生量の違いを定量的に明らかにするための観測を実施した。乾地研共同研究(代表:石塚正秀・香川大)などにおいて、土壌クラストの黄砂発生への影響の重要性を定量化するため、クラスト強度評価のための室内実験を実施した。

課題(3)では、乾地研共同研究(長田和雄・名古屋大)において、PM2.5観測など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1~3を繋げるため、乾地研共同研究(代表:関山剛・気象研究所)において数値モデルを用いた黄砂発生・輸送の研究を推進している。

これらは、日本学術振興会科学研究費(課題番号15H05115、25220201)、文部科学省特別経費事業黄砂プロジェクト、鳥取大学国際乾燥地研究機構経費、乾燥地研究センター共同研究において実施した。



Dust distribution on April 19, 2012. This image was produce 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 land, agricultural area, etc., and they are transported over a long distance by wind in free troposphere. We often observe dust particles emitted from 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 a 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 majorly three subjects, which are (1) monitoring of dust distribution, (2) elucidation of dust emission mechanisms and an application of them on numerical dust models, and (3) elucidation of the amount of deposited dust in Japan and its source regions. Major works done in the fiscal year are described as below.

On the subject (1), maintenance of the near-real time East Asia dust monitoring system using MODIS satellite images and meteorological observatory data was carried out. The images were utilized for discussion of emission places and transportation routes of dust with research colleagues.

On the subject (2), maintenance of dust emission observation system, which was set up at Tsogt-Ovoo Mongolia located in a northern part of the Gobi Desert under Project Asian Dust on March 2012, was carried out. In addition to the ordinal observation using the system, another observation was also carried out to quantitatively clarify a spatial difference in dust emission. Laboratory experiments were carried out to evaluate an importance of soil crust on aeolian erodibility under ALRC joint research (PI: Prof. Ishizuka, Kagawa Univ.) etc.

On the subject (3), observations of PM2.5 etc. were carried out on the roof of ALRC building under ALRC joint research (PI: Prof. Osada, Nagoya Univ.). To connect subjects 1-3, a research using numerical dust model was carried out under ALRC joint research (PI: Dr. Sekiyama, Meteorological Research Institute).

These works were supported by JSPS KAKENHI Grant Numbers 15H05115 and 25220201, by MEXT Project "Assessment and control of dust emission in degraded drylands of East Asia" (Project Asian Dust), by International Platform for Dryland Research and Education (IPDRE), and by ALRC joint researches.

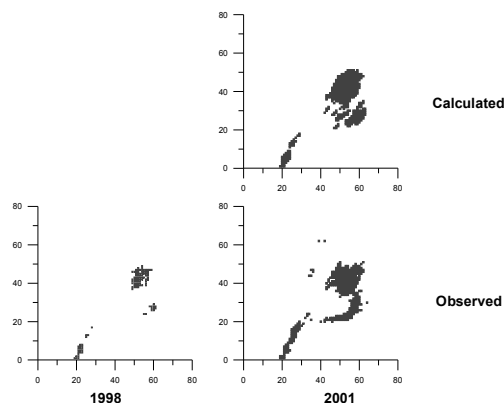


Dust emission observation system set up in Tsogt-Ovoo Mongolia located in a northern part of the Gobi Desert.

安田 裕 (水文学)

乾燥地での最大の問題は、きわめて単純で、水がないことである。この乾燥地で最重要である水につき研究を行ってきた。

1. スーダン東部 Kassala において、リモートセンシング解析と Ground truth を行い、外来侵入樹種メスキートの拡散過程を解析した。メスキート高密度域は、特定範囲の空間平均土壌水分に対してガウス分布を示していた。生物種拡散統計モデルの構築に着手した。
2. スーダン全土の降雨量時系列につき、全球海水面温度 (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. ミャンマー中部乾燥地域の月平均降雨量分布は、前雨季、後雨季のダブルピークを示す。それぞれの雨季降雨量の経年時系列は全球海水面温度 (SST) とリンクを持ち、数ヶ月前の SST と雨季降雨量の相関は 0.6 以上であった。SST からの雨季降雨量の予測モデルの開発が示唆されている。また、日雨量データから雨季の期間を同定した。年ごとに大きく変動していた。
4. ペルー北部海岸乾燥地帯は年雨量が 100 mm 以下であるが、東部山岳部から流下する河川水・地下水による農業生産が行われている。海岸乾燥地帯及び山岳部の降雨量時系列は、ペルー沖の海水面温度と極めて有意な強相関を呈していた。1983, 1998 年のエルニーニョ年には平年値の数倍の降雨が記録されていた。
5. 乾燥地の土壌は非均一性が強く移動現象をダイナミクスで評価することは困難である。本件研究にあつて、エジプト北東部で浸透実験が実施され、結果をフラクタルの一種である Diffusion Limited Aggregation (DLA) モデルで解析した。モデルパラメーターの最適同定には遺伝子アルゴリズムが用いられた。移動現象は著しい非均一性を呈していた。また、土壌特性により、移動現象は大きな差異を示していた。DLA により断面平均浸透を再現できた。

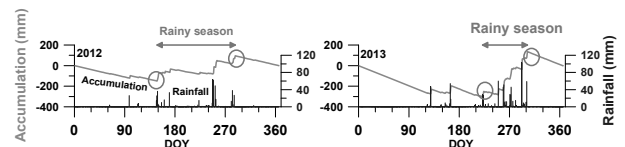


Numerical simulation of mesquite spread in Sudan. A two dimensional statistical model was applied.

Hiroshi Yasuda (Assoc. Prof., Hydrology)

Most serious problem in arid land is quite simple. There is not water. I have worked for water problem for this fiscal year.

1. In Kassala of east Sudan, remote sensing analysis and land truth were performed to evaluate the dispersion process of alien plant species, mesquite. Region corresponding to high density of mesquite spread indicated the Gaussian distribution for soil moisture in a specific range. Construction of a statistical numerical model for biological species dispersion has been started.
2. Teleconnection of rainfall time series over Sudan with Global Sea Surface Temperature (GSST) was clarified. There are significant correlations with SST over the Atlantic Ocean and Indian Ocean. A rainfall prediction model using the significant correlations was developed.
3. The monthly average rainfall of the dry area in the central Myanmar indicates double peak, the early monsoon and late monsoon. There are links of the inter-annual rainfall time series of the rainy season with GSSTs. A prediction model using the links is suggested. The rainy season was identified by daily rainfall data. The rainy season showed big fluctuation every year.
4. While the annual rainfall in coastal dry region of the northern Peru is less than 100 mm, agricultural productivity is available using river and groundwater flows from mountainous area in the eastern area. Rainfall time series of the coastal and mountainous area indicate extremely high strong correlations with SSTs in off the coast of Peru. Rainfall several times of the average was recorded in 1983 and 1998, the El Nino years.
5. Since heterogeneity of soil property is so predominant in arid land, transport phenomena is difficult to be evaluated by dynamic models. In this study infiltration experiments were conducted in the northeastern Egypt and results were analyzed by a Diffusion Limited Aggregation (DLA) model, one of fractal model. For the optimization of the parameters the Genetic Algorithm was applied. The transportation process indicated apparent heterogeneity. There were great different on the transportation phenomena due to soil properties. The DLA model reconstructed the infiltration in the horizontal average.



Identification of the rainy season in the central dry zone of Myanmar.

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、黄砂発生のホットスポットについて以下の研究成果を得ることができた。

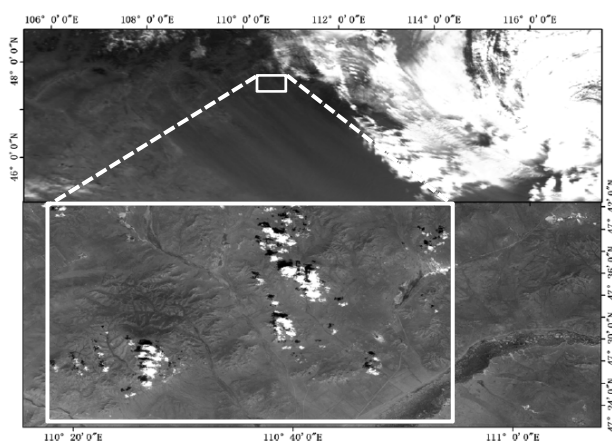
1. 2000～2013年の解像度1kmのMODIS衛星画像と解像度30mのLandsat衛星画像を用いることにより中国東部およびモンゴルにおける黄砂発生ホットスポットを解析したところ、科爾沁（ホルチン）沙地、浑善达克（オチンタグ）沙地、およびモンゴルゴビ南東部の3地域が特定された。

2. モンゴル南東部のホットスポットは2006年以降、北に向かった移動していることが示された。

3. ホットスポットは、干上がった湖、河床、鉱山および農耕地がダスト発生に大きく寄与している。

4. ダストホットスポットは、オチンタグ沙地およびモンゴルゴビの一部では産業活動の進展と、ホルチン沙地およびモンゴルゴビの一部では農業地域と一致している。

[Zhang, Tsunekawa, Tsubo. 2015. Identification of dust hot spots from multi-resolution remotely sensed data in eastern China and Mongolia. *Water, Air & Soil Pollution* 226:117]



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

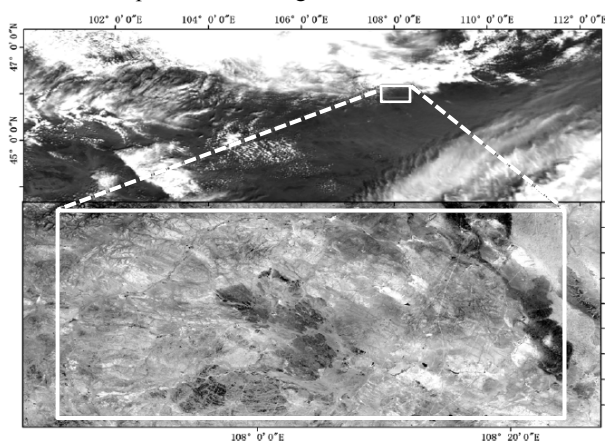
We obtained the following research findings about dust hot spots in eastern China and Mongolia in the fiscal year 2015:

1. Analysis of MODIS data (1 km resolution) and Landsat data (30 m resolution) indicated that three subregions of the eastern China and Mongolia source region are the dominant sources of dust: Horqin Sandy Land, Otintag Sandy Land, and the southeastern Mongolian Gobi.

2. Our data indicated that hot spots in southeastern Mongolia have migrated northward since 2006.

3. Our study showed that hot spots such as dry lakes, river beds, mines, and croplands contribute to dust emissions in the eastern China and Mongolia source region.

4. Dust hot spots coincide with regions of expanding industry in Otintag Sandy Land and in some areas of the Mongolian Gobi and with agricultural areas in Horqin Sandy Land and in some parts of the Mongolian Gobi.



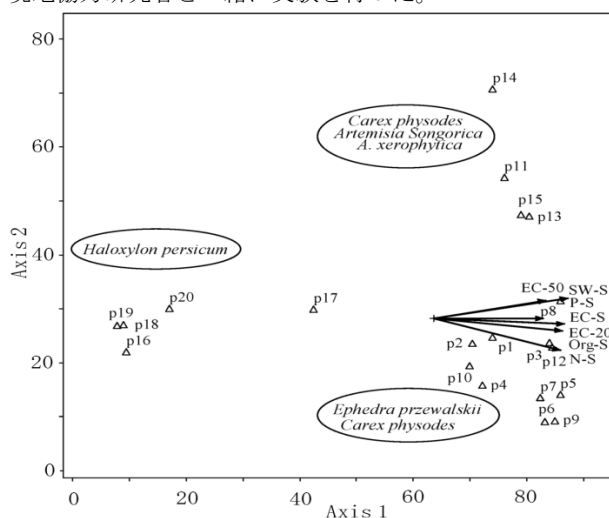
MODIS L1B images (1 km resolution) of dust hot spots (marked with squares) and their corresponding Landsat images (30 m resolution) for Mongolian Gobi. Rectangles on MODIS images (above) show locations of dust hot spots. Landsat images (below) show the underlying land use of the areas within rectangles on the corresponding MODIS images. (Zhang et al., 2015)

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。

1. トマト、ワタおよび塩生植物の耐塩性機構の解明。
2. 作物の根の特性と環境ストレス耐性との関係の解明。
3. 経済価値の高い塩生植物の栽培技術開発。
4. 塩水灌漑による栽培技術の開発。
5. 中国の砂漠と砂漠化地域における植物の分布調査。
6. 根の細胞壁の化学性・物理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、中国科学院遺伝与發育生物学研究所農業資源研究センターを訪問し、共同研究として、中国渤海湾沿岸の塩性土壤を視察し、塩生植物の分布を調査した。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。また、本センター特定共同研究「中国極乾燥地民勤オアシスにおける環境保全型農業の生産性向上に関する研究」を推進するため、中国科学院寒区乾区環境与工程研究所を訪問し、現地協力研究者と一緒に実験を行った。



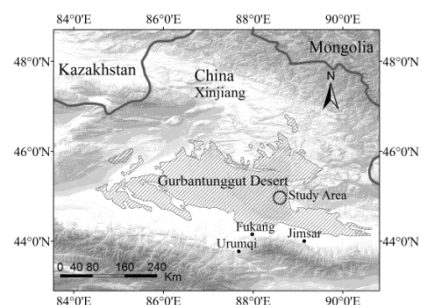
Canonical correspondence analysis (CCA) plots ordination of vegetation in the east central area of Gurbantungqut Desert.

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:

1. Salt tolerance mechanisms in tomato, cotton and halophytes;
2. Relationship between root and plant salt tolerance;
3. Development of cultivation techniques of halophytes with high economic value;
4. Application of saline water for crop irrigation;
5. Vegetation distribution in the desertified areas of China;
6. Relationship between the chemical and physical characteristics of root cell wall and salt tolerance in crops.

Overseas research activities during the fiscal year 2015 include several visits to the institutions of China. 1) Center for Agricultural Resources Research of the Institute of Genetics and Developmental Biology, Chinese Academy of Sciences (CAS). This visit was to conduct a field survey in the saline areas around Bohai Bay. The distributions of halophytes in saline soils were investigated. 2) Hebei Academy of Forestry Science. This visit was to investigate the growth of long-root seedlings planted in the sandy area of Hebei Province. 3) Institute of Botany of the CAS. This visit was to continue the field investigation of the vegetation in the desertified areas of north China. 4) Cold and Arid Regions Environmental and Engineering Research Institute, CAS. This visit was to initiate a new project about sustainable agriculture development in Minqing Oasis.



Geographical location of Gurbantungqut Desert (area with grids) and study area.

辻本 壽 (分子育種学)

地球環境変動下で、増加する人口が必要とする食糧をいかに生産するかが、人類の最大の課題であるといえる。不適環境でも成長でき、安定した収量を保障する穀物品種開発は、この問題の解決に重要であり、これを可能にするにはこの性質を付与する遺伝子の探索が必要である。私達は、乾燥地で最も重要な穀物であるコムギを改良するために、その頑健性遺伝子を、近縁野生植物のジーンプールの中に見出そうと研究している。

コムギ近縁野生植物は、乾燥、高温、塩害など、栽培コムギが生育できない地域においても生存する植物がある。したがって、これら野生植物が頑健性遺伝子をもつことは推察でき、実際、コムギ育種の遺伝資源として、ジーンバンクには多数の近縁野生植物系統が保管されている。しかし、コムギの野生植物の多くは、栽培コムギとは異なる倍数性であり、形態もかなり違うために野生植物の性質をいくらか詳細に調査しても、コムギ育種に利用可能な遺伝子を見出すことができない。

私達は、野生植物の頑健性遺伝子を的確に見出すため、材料および方法両面での工夫を行っている。まず、材料面においては、野生植物の遺伝的多様性をコムギに導入した集団を開発し、通常のコムギ品種と形態的に大差がない材料を用意した。これにより、野生植物の遺伝子であっても、コムギの形質を通じて、コムギの遺伝子として評価できるようになった。次に、この集団をスーダンの高温・乾燥条件下で栽培し、実際のフィールドにおける頑健性の程度を評価し、選抜した。一方、この集団を構成する個々の個体を、多数の分子マーカーで調査し、頑健性遺伝子に関わる遺伝子を検出しようとしてみた。

一方で、乾燥、高温ストレスに対する植物の応答を瞬時にハイスループットに定量化して評価するための技術を開発しようとして研究している。これにより、頑健性を示す個体を高精度に選抜できると考えている。

今後の食糧生産のためには、悪環境下における頑健性のみでなく、フィールドへのインプットを低減しても安定したアウトプットができる環境低負荷型品種 (エコ品種) の開発が必要であり、野生植物のジーンプールから、肥料や水を節約できる遺伝子についても興味を持っている。



Collaborative research with Sudan Agricultural Research Corporation about wheat dry and heat stress tolerance using wild genetic resources (Feb. 19, 2016, Hudieba Experimental Station, Sudan)

Hisashi Tsujimoto (Prof., Molecular Breeding)

Under the changing climate, how to produce the food that is needed for the increasing population is the biggest challenge for human beings. Development of crop varieties that can grow under the harsh unsuitable environment and security of stable and sustainable production are a significant and reliable solution. Thus exploitation of genes for this matter is needed. We are studying to discover the genes of robustness to improve wheat that is the most important cereal crop in dry areas.

There are wheat-related wild species that can grow under very harsh conditions, such as dry, hot and saline soil. Thus, it is inferable that these wild plants carry genes for robustness. Actually many wheat-related species are kept in the gene banks being regarded as potential genetic resources for wheat improvement. However, it is not easy to discover the expected genes of robustness because the morphology of the wild species, and also the genetic nature, as ploidy, of the plants, are very different from the cultivated bread wheat.

We are using unique materials and methods to exploit robust genes from the gene pools of wild species. Regarding the materials, we have developed experimental wheat populations maintain the diversity of wild species. Each plant in a population has similar morphology to the practical cultivar that used as a genetic background. In this population, the genes derived from the wild species are evaluated as wheat gene in normal wheat morphology. We evaluated the population under hot and dry conditions in the breeding fields in Sudan, to explore the robustness in each plant in the real stress condition, and to select the robust plants. We genotyped each plant in the population by many molecular markers. This study will elucidate the robust genes that act in the real stress condition and are useful for breeding.

We are now trying to develop technologies to quantify the plant response to dry and heat stresses in high-throughput and to select the robust plants in high accuracy.

In addition to these robust genes for the changing climate, we are now interested in the creation of wheat genotypes which secures stable production even by the low input of water and fertilizer in the field; we call the type of variety as 'Low Environment Burden Variety (LEBV)' or simply 'eco-variety.'



A wheat field in the high plateau dry area in China. (Aug. 8, 2015, Qinghai, China)

エリタイプ ハボラ E. アミン (生物工学)

乾燥地および半乾燥地で頻発している雨量変動により引き起こされる干ばつや水不足等の不適な気象条件は、農業生産にとり大きな脅威である。気候変動や地球温暖化による干ばつの発生回数や頻度は今後増加することが予想され、急速に増加する世界人口に対する十分な食糧の保障を脅かすだろう。このような状況下で、作物の限られた水資源に対する適応・対応能力増加を可能にする先進的な科学技術が必要とされている。栽培種の乾燥ストレス耐性を増加するためには、耐乾性を持つ新奇遺伝子を同定し、その機構を深く理解したうえで活用することが大切である。

生物工学分野では、遺伝子レベルの先進的科学技術を活用し、主に乾燥や塩害のような乾燥地特有のストレスに耐性をもつ新奇遺伝子や遺伝子ネットワークの同定を行っている。さらに、ソルガムのような重要な食用作物の適応機構に関する研究も行っている。本年度は、主に次のテーマについて研究を行った。

- (1) ステイ・グリーン特性の遺伝子機構同定および、それを活用した耐乾性ソルガムの育種。本研究は日本学術振興会からの支援を受け、東京大学およびスーダン農業研究機構と共同で行われているものである。本研究の目的は、雨季終期に干ばつが起こる傾向にある天水農業におけるソルガム生産量の増加であった。ソルガムに関する科学交流や共同研究の推進を目的とし、今年度2月スーダンにおいて、「乾燥地での持続可能な農業生産のための穀物遺伝子改良国際研修会」を実施した。
- (2) イネの耐乾性増加に寄与する可能性のある新奇遺伝子を利用したイネの形質転換植物の育成。
- (3) コムギの栽培種および近縁野生種に由来する育種素材の評価。

生物工学分野では、ソルガムの耐乾性に関する2つの研究を国内の2大学と共同で行った。さらに本分野では、博士課程学生および博士研究員の指導も行った。本年度の海外活動としては、国際原子力機関（オーストリア）、農業研究機構（スーダン）、国際半乾燥熱帯作物研究所（ICRISAT）（インド）での研究調整および、アメリカでの国際会議に出席した。



Evaluation of the Sudanese sorghum under drought inside fully controlled growth chambers.

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

Unfavorable climate conditions such as drought and water scarcity due to fluctuation of rainfall that prevails in the arid and semi-arid regions are considered major threat to the agricultural production. With climate change and global warming, more drought incidents and frequency are expected to occur, which threaten the food security of the rapidly growing population. This situation necessitates the use of advanced science technologies to improve the plants ability to adapt and cope with limited water resources. Identification and utilization of new genes for drought tolerance, coupled with detailed understanding of the tolerance mechanism are crucial for improving the ability of cultivated crops to adapt to drought condition.

The Biotechnology Subdivision utilizes advance technologies that operate at the gene level, to identify novel genes and genetic networks for adaptation to drylands environments, particularly drought and salt stresses. It also carries out research to understand the adaptation mechanism in important food crops such as sorghum. The main research themes of carried during the fiscal year 2015 are:

- (1) Research on identification of the genetic mechanism of Stay-Green trait, and its application for breeding drought tolerant sorghum. This research is funded by the JSPS, and is conducted in collaboration with Tokyo University and the Agricultural Research Corporation of Sudan. The aim is to improve sorghum production in rainfed sectors where drought occurs at the end of the rainy season. An “International Workshop on Genetic Improvement of Cereals for Sustainable Production in Arid Lands” was organized in Sudan on February 2015 to facilitate more scientific exchange and collaboration on sorghum research.
- (2) Genetic engineering of transgenic rice to test new genes that could be useful to enhance drought tolerance.
- (3) Evaluation of breeding materials derived from cultivated and wild relatives of wheat crop.

During this fiscal year, the biotechnology subdivision carried out two joint research projects with two Japanese universities on the field of drought tolerance of sorghum. Additionally, biotechnology subdivision has contributed to supervision of the research of Ph.D. and postdoctoral fellows.

Oversea activities during the fiscal year included research coordination visits to the International Atomic Energy Agency (Austria), Agricultural Research Corporation (Sudan), International Crops Research Institute for the Semi-Arid Tropics, ICRISAT (India), and international conference (USA).

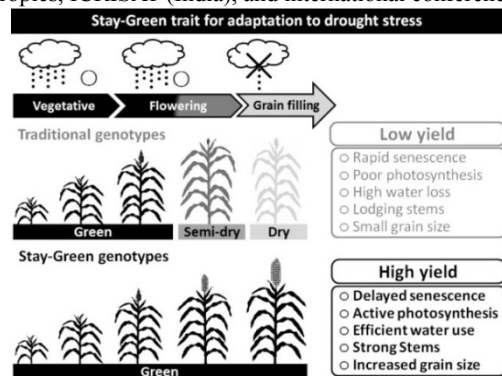


Illustration of the Stay-green trait that enhances sorghum adaptation to drought stress

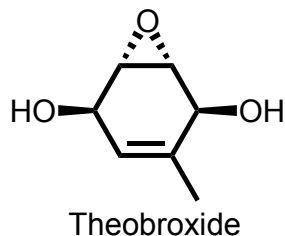
岡本 昌憲 (植物分子生物学)

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
- 選択的アブシジン酸(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、作物研究所などの研究機関と共同で研究を行っている。本年度は以下に示す成果を得た。

- 1.糸状菌が生産するセオブロキシンドを植物に投与することで、ABA 不活性化酵素遺伝子の発現が抑制され、内生 ABA 量の増加により、耐乾性が向上する事が明らかとなった。
- 2.mRNA の代謝に関わる LSM5/SAD1 は、熱ストレスで誘導される異常な RNA 群を分解へ導くことで、植物の熱ストレス耐性に関わっていることが明らかとなった。
- 3.新奇の ABA アゴニストとアンタゴニストの開発に成功した。



Theobroxide is originally isolated from the filtrate of *Lasiodiplodia theobromae* as a potato tuber-inducing stimulus.

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

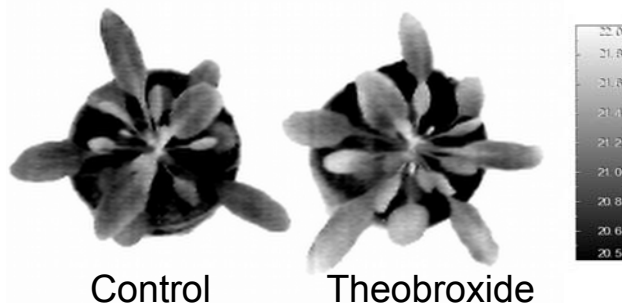
Higher plants are sessile organisms. Therefore, plants have complex defense system for various environmental stresses (cold, drought, heat and high salt stresses). In our laboratory, main goal is to elucidate molecular mechanism for stress responses using *Arabidopsis* or wheat as plant materials. Additionally, 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, Shizuoka University and NARO Institute of Crop Science.

The followings are highlights in this fiscal year.

1. Theobroxide treatment increased endogenous ABA levels by regulating ABA catabolic pathway and conferred drought stress tolerance in plants.
2. We revealed that *Arabidopsis* LSM5/SAD1 functions to degrade aberrant transcripts through appropriate mRNA splicing and decapping, and precise RNA metabolic machinery is required for heat stress tolerance.
3. Novel ABA agonist and antagonist developed by chemical screen and rational chemical design.



Theobroxide treatment reduces transpirational water loss and confers drought stress tolerance in *Arabidopsis* plant. Thermal images are taken 2d after chemical treatment.

3) 緑化保全部門

藤巻 晴行 (土壌保全学)

土壌保全学分野では、乾燥地・半乾燥地における塩類集積の数値予測と土壌劣化（土壌侵食、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) JSPS 二国間共同研究「パレスチナ西岸地区におけるウォーターハーベスティングによる食料安全保障の強化」

2) 共同研究（特定研究）「パレスチナにおける下水処理水および脱塩処理水を利用した熱帯果樹栽培」

3) 限界地プロジェクトの栽培グループの活動として「植物の生長モデルと天気予報を用いた灌漑水量の決定」に関する研究

4) 住友電工との共同研究「サンドポニックスおよび底面給水栽培システムの水管理および塩分管理に関する研究」

1 については、ラマラ市郊外の傾斜地に土壌水分および流出モニタリングシステムを設置するとともに、ビニールシートを用いたウォーターハーベスティングシステムを設置し、観測および栽培実験を行った。

2 については、ジェリコ市の下水処理場内に実験圃場を設置し、マンゴーとグアバを供試作物とする灌漑実験を行った。

3 については、センター内砂地圃場でジャガイモおよびラッキョウを供試作物とする灌漑実験を行った。また、ヨルダンでも小麦を供試作物とする灌漑実験を行った。いずれも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。

4 については、センター内のビニールハウスでトマトを供試作物とする灌漑実験を行った。

また、以下の海外活動を行った。

1. 「パレスチナ西岸地区におけるウォーターハーベスティングによる食料安全保障の強化」の遂行のためのパレスチナ出張（4回、のべ28日）
2. 限界地プロジェクトに係る灌漑実験のためのヨルダンおよびパレスチナ出張（3回、のべ21日間）



Demonstrating a water-harvesting system in the West Bank

3) Afforestation and Land Conservation Division

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) JSPS bilateral collaborative research fund “Enhancing Food Security using water harvesting in West Bank of Palestine”

2) Cooperative Research Program of ALRC “Tropical fruit tree cultivation using sewerage treatment water and desalination processing water in Palestine”

3) Determination of irrigation depths using a numerical model and quantitative weather forecast as an activity of husbandry group under the “Project Marginal Land”.

4) Water and salinity management for a sand-ponics and an upward irrigation system as a cooperative research with Sumitomo Electric Industry.

Regarding to 1), experiments using a monitoring system for soil moisture and runoff and water harvesting system in a slope in suburb of Ramallah were carried out.

Regarding to 2), an irrigation experiment for Mango and Guava was performed in Jericho municipal wastewater treatment plant.

Regarding to 3), irrigation experiments using Potato and Rakkyo (a Japanese variety of garlic) were carried out in ALRC. We also carried out an irrigation experiment using Wheat in Jordan. Two dimensional simulation model for determining irrigation depth of drip irrigation, WASH_2D, was applied to the experiments.

Regarding to 4), irrigation experiments using Tomato were carried out in ALRC.

Overseas research activities during the fiscal year were:

1. visits to Palestine for four times for topic 1.
2. visits to Jordan for three times for topic 3.



Mango growing in the experimental field in the West Bank

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。

- (1) 乾燥地における植物群落の生態学的研究
- (2) 樹木の耐乾・耐塩性に関する生理生態学的研究
- (3) 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、スーダン、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): プロジェクトの取りまとめとして、丸善出版より「黄砂 健康・生活環境への影響と対策」を出版した。
2. 黄砂発生源域における草原生態系の菌根共生とグロマリン蓄積(科学研究費 (B)): モンゴル黄砂発生源域の草原生態系において、菌根共生系とグロマリン蓄積に関わる現地調査を行った。本年はモンゴル・マンダゴビ地域のステップ植生を対象に、家畜の食害に対する植生構造の変化を明らかにした。
3. 日本・中国 (JSPS - NSFC) 二国間交流事業/共同研究 (日本学術振興会): 中国黄土高原において、二国間交流事業“Water Use and Nutrient Cycling in Typical Forests of the Semiarid Loess Plateau, China”に関する野外調査を行い、塩類集積地における土壌中のナトリウム及び窒素分布に与える塩生植物タマリスクの影響を明らかにした。



Vegetation survey in Gobi steppe area in Mandalgovi, Mongolia (August 2015).

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.

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

These researches have been conducted with overseas research institutions in China, Mongolia, Sudan, 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): To finalize the project, We published “Asian dust - effects on human health and environment, and counter measure.”(supervised by ALRC, edited by Y. Kurosaki, Y. Kurozawa, M. Shinoda and N. Yamanaka) by Maruzen Publishing Co. in FY 2015..
2. Glomalin accumulation and arbuscular mycorrhizal symbiosis of grassland ecosystem in dust source areas (JSPS Grant-in-Aid for Scientific Research(B)): Field research on the Glomalin accumulation and arbuscular mycorrhizal symbiosis of grassland ecosystem was conducted in Mandalgovi, Mongolia. We elucidated the effects of grazing pressure on vegetation structure in steppe areas of Mongolia.
3. Japan-China (JSPS-NSFC) Bilateral Joint Research Projects (JSPS): We conducted field researches on “Water Use and Nutrient Cycling in Typical Forests of the Semiarid Loess Plateau, China” and the effects of halophytic plants (*Tamarix austromongolica*) on salt and nitrogen distribution in salt accumulated areas are elucidated.



The 3rd Seminar on Water Use and Nutrient Cycling in Typical Forests of the Semiarid Loess Plateau, China. (June 2015, at ISWC,)

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、ミクロス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。

中国、クブチ砂漠において外生菌根菌が緑化樹種、アブラマツ (*Pinus tabulaeformis*) の生存、成長に及ぼす影響について調査を行った。外生菌根菌の接種効果を検証するため、土壌を接種しない処理区 (NM)、菌根菌を含む土壌を殺菌剤処理後に接種した処理区 (SF)、菌根菌を含む土壌を接種した処理区 (SM) の3処理区を設けた。接種土壌は成長が良好な内蒙古自治区に位置する植林地から採取した。クブチ砂漠において、植栽1か月後のマツ実生根域に土壌に添加することで菌根菌の接種を行った。結果として、菌根菌を接種した処理区 (SM) では、3年後のアブラマツの伸長量や総重量が増加していた (Tukey's test, $P < 0.05$)。また、外生菌根菌の形成率に関する調査を行ったところ、菌根菌を含む土壌を接種した処理区 (SM) では形成率が高く (Tukey's test, $P < 0.05$)、この形成率と総重量の間には正の相関が確認された ($R^2 = 0.74$, $P < 0.001$)。また、菌根菌を含む土壌接種区 (SM) では、土壌を接種しない処理区 (NM) や菌根菌を含む土壌を殺菌剤処理後に接種した処理区 (SF) と比べて共生する菌種数が多く、機能的に多様な菌が共生していることが推察された。



P. tabulaeformis seedlings after 3 years from soil inoculation.

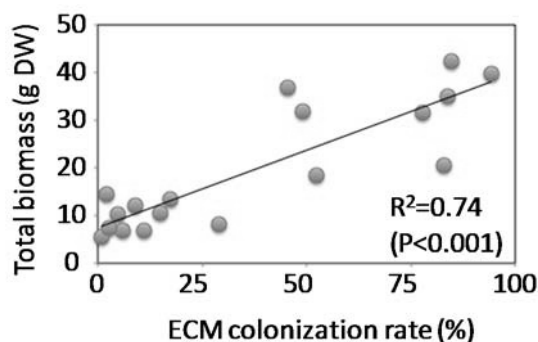
Takeshi Taniguchi (Assoc. Prof., Microbial Ecology)

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

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

Effect of ectomycorrhizal (ECM) fungi on survival and growth of *Pinus tabulaeformis* seedlings were examined in Kubuqi desert in Inner Mongolia, China. Three treatments (no mycorrhizal fungi-inoculated (NM), soil with fungicide-inoculated (SF), and soil with mycorrhizal fungi-inoculated (SM) treatments) were established. After 3 years, shoot height and total weight of the seedlings increased (Tukey's test, $P < 0.05$). ECM colonization on roots was significantly higher in SM than those in NM and SF (Tukey's test, $P < 0.05$). Positive correlation between total biomass and ECM colonization of pine seedlings was detected by regression analysis ($R^2 = 0.74$, $P < 0.001$). ECM fungal diversity was also higher in SM, indicating that mycorrhizal fungi with various function colonized on pine seedlings in SM.



Regression between total biomass and ectomycorrhizal colonization of pine seedlings.

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。とく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。

本年度から、環境の予測可能性と不均一性を考慮した野生動物にとっての重要地域検出を目指したプロジェクトを開始した。また、モンゴル西部のアルタイ山脈に生息するユキヒョウの保全生態学的研究や、モンゴルの伝統的食品である馬乳酒生産に使われるウマの行動学的研究をおこなった。鳥取砂丘を対象とした野生動物研究も開始した。本年度はとくに以下の研究で成果を得た。

1. モンゴルの長距離移動有蹄類の保全生態学的研究：モウコガゼルの追跡データと環境情報データから、モンゴル南部における冬季と夏季のモウコガゼルの生息適地を推定した。とくに冬の生息適地の空間分布の年変動が大きく、建設中の鉄道が動物の移動を阻害する場合、モウコガゼルが利用できる生息適地がほとんどない年が出現することを明らかにした。モウコガゼル分布域北部で新たな衛星追跡を開始し、糞中 DNA による植物の科レベルでの野生有蹄類と家畜の食性評価もおこなった。また、モウコガゼルの遺伝子構造に関する論文を出版した。
2. ユキヒョウの保全生態学的研究：モンゴル西部のアルタイ山脈で、糞 DNA 分析を用いたユキヒョウの個体数推定および個体群間の遺伝的交流に関する研究を開始し、アルタイ山脈での糞サンプル採集に成功した。
3. 馬乳酒生産用ウマの行動研究：モンゴルの馬乳酒名産地における、馬乳酒生産用ウマの管理手法とウマの追跡調査から、日中と夜間のウマの移動距離や行動圏が大きく異なることを明らかにした。
4. 鳥取砂丘の動物研究：無人航空機 (ドローン) に赤外線カメラを搭載したシステムを製作し、夜間でも熱画像による動物検出が可能であることを確認した。



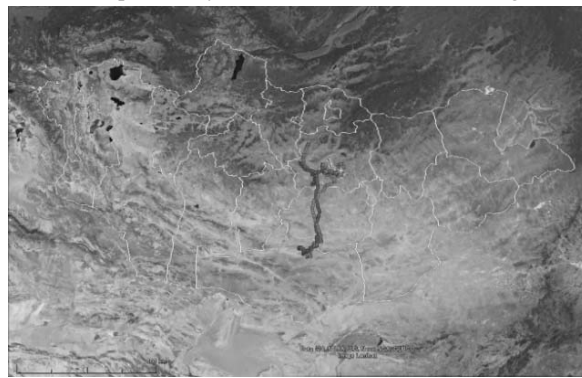
A view of the study site and capturing Mongolian gazelles in Mongolia in September 2015.

Takehiko Ito (Assist. Prof., Animal Ecology)

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

From this fiscal year, we started a new project on detection of important areas for wild mammals in Mongolia by evaluating habitat predictability and heterogeneity. Researches on snow leopards and domestic horses in Mongolia and on wild animals in Tottori Sand Dunes were also conducted. In the fiscal year, we obtained results on the following researches:

1. Conservation ecology on long-distance movement ungulates in Mongolia: Habitat suitability maps in winter and summer for Mongolian gazelles in south Mongolia were made from location data of satellite tracked gazelles and environmental data. We suggested a threat of small suitable areas in severe winters if the constructing railroads have strong barrier effects on gazelles, due to the large inter-annual change of spatial distributions of suitable areas. New satellite tracking of gazelles were started in the northern part of the gazelle distribution. We evaluated food habits of wild and domestic ungulates into the plant family level by fecal DNA analysis. A paper on genetic structure of Mongolian gazelles was published.
2. Conservation ecology on snow leopards in Mongolia: We visited snow-leopard habitats in Altay Mountains and collected snow-leopard fecal samples for DNA analysis.
3. Behavioral study on domestic horses for *airag* production: We revealed the great differences of horse movements between daytime and nighttime by GPS tracking in a famous area for high-quality *airag* in Mongolia. It suggested importance of site selection and milking schedule by herders for horse and grassland managements.
4. Research on wild animals in Tottori Sand Dunes: Animal monitoring system using an unmanned aerial vehicle (UAV, drone) and a near-infrared camera was adopted, and we confirmed possibility of animal detection even at night.



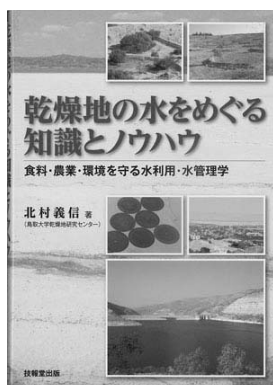
Movements of tracked Mongolian gazelles from the end of September 2015 to mid-January 2016.

北村 義信 (乾地水管理学)

特任教授として、「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)の研究推進に従事した。そのほか以下の研究等に取り組んだ。

- 1) JICA-JST 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」に係る研究の取りまとめ
- 2) 図書「乾燥地の水をめぐる知識とノウハウ：食料・農業・環境を守る水利用・水管理学」の執筆と出版
- 3) 中国・黄土高原チェックダム農地における塩害の進行に関する研究
- 4) 中国洛恵渠灌区における作付け割合の変化が取水管理に及ぼす影響に関する研究
- 5) ヨルダンの農業、灌漑、水資源管理に関する研究動向調査
- 6) JIRCAS 海外農業農村地球環境問題等調査事業 (地下水制御による農地塩害対策調査)検討委員会委員としての現地 (ウズベキスタン) 調査と助言

これらの研究活動の成果については、学会等で発表するとともに国際誌などに公表した。また、乾燥地の灌漑農地における塩類集積に関する研究の一部が NHK 教育テレビ・サイエンス ZERO:「食糧危機の切り札！耐塩性作物」(2015年9月6日、午後11時30分～12時放映)にて紹介された。



Prof. Kitamura published a book titled "Knowledge and know-how on water in drylands".

Yoshinobu Kitamura (Specially Appointed Prof., Agricultural Water Use and Management)

As a Specially Appointed Professor, I have worked on the research project on "Assessment and control of dust emission in degraded drylands of East Asia (Project Asian Dust)". In addition to this, the following activities were conducted:

- 1) Conclusion of the JICA-JST project (SATREPS), "Sustainable systems for food and bio-energy production with water-saving irrigation in the Egyptian Nile basin".
- 2) Writing and publishing a book whose title is "Knowledge and know-how on water in drylands: Water use and management to protect food safety, agriculture and environment".
- 3) Study on development of soil salinization of check-dam farmlands in the Loess Plateau of China.
- 4) Research on impact of cropping pattern change on water intake management in Luohui Irrigation District, China.
- 5) Survey of research trends in agriculture, irrigation and water resources management in Jordan.
- 6) Field survey and advice in Uzbekistan as a steering committee member for "JIRCAS overseas research project on global environmental problems in agriculture and rural area (Research to prevent farmland salinization based on groundwater control).

Some of the above research results were presented in academic meetings, and published in international and domestic journals. Part of a series of research on secondary salinization of irrigated farmlands in arid region was introduced in the NHK Educational TV program titled "Science ZERO: Saviors of the Global Food Crisis! Development of Salt-tolerant Crops", aired on September 6, 2015, 11:30 PM - 12:00 PM.



Prof. Kitamura attended JIRCAS Workshop on secondary salinization and made a general comment as a Steering Committee member (held in Tashkent, Uzbekistan).

4) 社会経済部門

小林 伸行 (社会経済学)

畜産：

乾燥地の開発においては、自然環境の保全、住民の生計向上と生活改善とのバランスのとれた総合的・持続的な開発が重要であるとの認識に立ち、畜産による土地利用とこれによる自然環境とのバランスある発展をいかに維持していくか、各地・国の状況に鑑み、適応可能な策を検討・提示することを目指す。これに関し、2015年度から、中国・蘭州大学との共同研究を行っている。

中国では、牛肉消費量の急増に対する飼料給与量の抑制のため、飼料の効率的な利用体系の構築が求められている。同国内用牛生産の重点地域である甘粛省でも舎飼い飼養が推奨されるが、草地利用型の畜産が行なわれてきた同省では舎飼い飼養管理は普及途上にある。このため、同省で一般的に播種・栽培され、タンパク質含量や耐旱性の高さから肉用牛飼料としての有用性が高いと考えられるアルファルファ乾草 (AH) で濃厚飼料 (C) を代替した際の増体成績およびエネルギー出納成績に及ぼす影響を調査している。

これまでに以下の結果を得た。

1. CをAHで代替しても、増体量の減少やメタン排出量の増加をもたらす中性デタージェント繊維 (NDF) 含量の増加にかかわらず、乾物摂取量は減少しなかった。
2. AHによるCの過剰の代替は飼料・エネルギー効率の低下をもたらすが、一定の範囲内ではAHによる代替が増体成績に大きな影響を及ぼさないと考えられた。
3. 飼料計画での経済性を考慮すると、所定の増体量 (日増体量 1kg) を達成するにはAHの混合が可能と思われた。

国際協力：

乾燥地技術の適用現場の多くが途上国にあることから、その普及のため、これら国々の関係者を研修員として受け入れ、現地でのプロジェクトを実施している。

1. JSTによる「さくらサイエンスプログラム」を通じ、中国・旱区寒区環境工学研究所の若手研究者を中心とする10名を受け入れた (2016年2月、10日間)。
2. 国際乾燥地研究教育機構「人間開発と健康グループ」によるフィリピンでの「生活の質改善を目指した糖尿病予防プロジェクト」の実施に向けた準備を行い、JICA草の根技術協力による支援の内定を得た。



Respiratory chambers were used to measure the energy metabolism of beef cattle in China.

4) Socioeconomics Division

Kobayashi Nobuyuki (Assoc. Prof., Sociology/Economy)

Livestock: Recognizing that comprehensive/ sustainable development with environmental conservation and farmers' livelihood improvement is important especially in dry lands, we aim to discuss/ propose applicable measures for achieving both land utilization and environmental conservation with livestock raising. In this regard, the collaborative research with Lanzhou University in China has been implemented since 2015.

In china, in order to prevent the increase of feeding amount for beef cattle caused by the increasing consumption of beef meat, the establishment of system to efficiently utilize feed is required. In Gansu Province, one of the prioritized area for beef cattle production, feeding cattle in the pen is promoted. However as livestock raising with utilization of grassland have been prevalent there, the 'pen feeding' is under development. It is thus expected that the alfalfa, generally sown and cultivated in the Province, can be utilized as the feed of beef cattle, since it is high in the protein content and the resistance against drought. The collaborative research aims to study the effect of replacement of concentrate (C) with alfalfa hay (AH) on body weight daily gain (DG) and energy metabolism.

The following outputs have been obtained in 2015.

1. The replacement of C with AH didn't influence the DMI decline in spite of the NDF increase, which supposedly cause the increase of methane emission and the DG decline.
2. Certain amount of mixed AH would not significantly influence DG decline, though its higher substitution rate tended to reduce the dietary and energy efficiency.
3. Considering the importance of economic feasibility, the groups with AH, less costly for 1kg DG, seemed preferable.

International Cooperation: The most technologies for drylands are applied in developing countries, the training for those concerned with their application/extension and the research/development projects have been implemented.

1. Receiving 10 young researchers of Cold and Arid Regions Environmental and Engineering Research Institute, Chinese Academy of Sciences, through SAKURA Science Program of JST (Feb. 2016; 10days).
2. Commencement of 'Project for enhancing the preventive measures for diabetes in Philippines' tentatively approved as JICA funding.



Interview for diabetic patients in the target community of Project in Philippines.

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

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

April 1, 2015 – September 30, 2015

Development of enzymatic methods for accurate determination of betaines in plants sample: From the Lab to the Field

During the past 12 months of my research, I have involved in several research activities related to my research topic and interests. The main aim of these activities was to develop enzymatic methods for determination of betaines in plant samples as well as to understand the biochemical mechanism of plants tolerance to abiotic stresses mainly salinity and drought. To achieve these goals the following research activities had been carried out in the past twelve months:

Firstly, I conducted a field survey and collected mangrove samples from the mangrove forests in red sea coast of Port Sudan (14 Oct. 2014 - 30 Oct. 2014). The samples were collected from two mangrove-growing sites, one in South Port Sudan and the other in North Port Sudan. The collected leave samples from the mangrove trees in the two locations were dried in an oven at 60°C for two days and then powdered by mortar. The powdered samples were then used for the analysis of betaines and cations.

Secondly, we conducted field survey and collected Mesquite (*Prosopis juliflora*) and soil samples from different saline, sodic and saline/sodic area in Sudan (20 May 2015-2 June 2015). We analyzed the plant samples for betaine and cations concentration using capillary electrophoresis and atomic absorption spectroscopy, respectively. In another research activity during our last research visit to Sudan, we conducted an experiment on the stimulation of gum resin production from mesquite trees, and we are planning to analyze the quality of the produced gum.

Thirdly, we conducted lab experiments on the cloning and characterization of mammalian betaine homocysteine methyltransferase (BHMT) and bacterial γ -butyrobetainyl CoA synthetase in order to use them for the estimation of glycine betaine and γ -butyrobetaine, respectively. In addition, we assessed the activity and specificity of the recombinant enzymes.

Lastly, I attended an open seminar and delivered presentation about the impact of drought and desertification on food and nutrition security in Sudan. I also attended meetings about the extension of the memorandum of understanding between Tottori University and the University of Khartoum. Moreover, I attended meetings and presentations about the

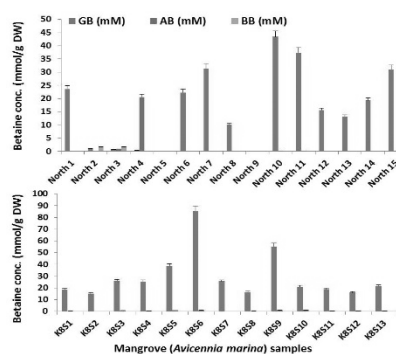
Substrate	Structure	Relative activity (%)
γ -Butyrobetaine		100
Dimethylaminobutyric acid		55
D-Carnitine		18
L-Carnitine		6.7
Monomethylaminobutyric acid		2.4
β -Alaninebetaine		0.7
γ -Aminobutyric acid		0.3
Glycinebetaine		0.0
Butyric acid		0.0

Substrate specificity of γ -butyrobetainyl CoA synthetase on different substrates

initiation of collaborative research projects between ALRC and University of Khartoum (Desertification Research Institute and Faculty of Forestry). In addition to that, I prepared and submitted manuscripts about my research.

The enzymes for betaine analysis had been proficiently overproduced and initially characterized for their activities and substrate specificities. The recombinant enzyme betaine homocysteine methyl transferase showed great ability to catalyze glycine betaine in the presence of homocysteine and forms dimethylglycine and methionine as reaction products. This result is promising because coupling this enzyme with dimethylglycine oxidase could significantly be used for accurate measurement glycine betaine and/or development of glycine betaine biosensor. In addition, the recombinant enzyme γ -butyrobetainyl CoA synthetase also showed significant activity and specificity toward γ -butyrobetaine (Table 1) compared to other structurally related substrates. The enzymes showed a very narrow range of substrate specificity as it mainly reacted with γ -butyrobetaine and to a lesser extent with dimethylamino butyric acid. This result also demonstrated that this new enzyme could efficiently be used for estimation of γ -butyrobetaine in many samples as well as it could also be used for biosensor development. Collectively, we succeeded in the overproduction of recombinant enzymes, and we evaluated the possibility of using them in betaine biosensors. Future research shall specifically focus on the using of these enzymes in the betaines biosensors and evaluating the biosensor performance for the analysis of real samples.

On the other hand, analysis of betaines of mangrove (*Avicennia marina*) leaves samples collected from the mangrove forests in Red Sea coast of Port Sudan indicated abundance of glycine betaine in most of the samples (Fig. 1). With exceptions of samples north 2, north 3 and north 4, all other samples showed considerable amounts of glycine betaine with very low amounts of β -alaninebetaine in some samples. Interestingly, sample north 4 showed high amounts of β -alaninebetaine instead of glycine betaine and this sample also showed different leave shape and size suggesting that it might be belongs to other mangrove species. In addition, the mangrove samples also showed considerable amounts of cations mainly sodium and potassium. However, some samples (north 4 and north 9) indicated significantly higher concentration of calcium compared to other samples, and interestingly sample north 4 is one of them suggesting that this is a different mangrove species. Overall, these results open the doors for further in-depth evaluation of the biochemical mechanisms of salt tolerance in mangrove plants growing at the Red Sea Coast of Port Sudan.



Betaines analysis of *Avicennia marina* growing at the Red Sea Coast of Port Sudan.

Firew Tegegne Amogne (Assoc. Prof., Animal Nutrition)

October 2014 - September 2015

Identification of plant species suitable for biological conservation and their nutritional characterization

A study was carried out with the objectives of: 1) examining the policy environment and protocol of selecting forage plant species, 2) documenting the types of plant species used for biological conservation, 3) determining the chemical composition of the palatable/forage species and 4) assessing the perception of farmers on conservation-based forage production & utilization.

Document analysis, field observation, key informant interview (experts and officials), focused group discussion (farmers), semi-structured questionnaire (farmers) and chemical analysis of forage samples were used as tools. After developing the study tools (Nov. & Dec. 2014), the field work was carried out from Jan. 5 to Feb 4, 2015. The study was done in two zones (five villages) of Amhara Region, Ethiopia. Total of 175 (35 interviewee/village) were selected randomly.

The survey revealed that: 1) With respect to the Ethiopian government's plan to transform agriculture, though there are some encouraging developments, transformation in the livestock sector is not happening. The main reasons, according to key informants are: lack of attention, incentives, alignment/coordination among sector offices/bureaus and knowledge gap; 2) At farmers' level, the main constraints of livestock production are animal health, lack of feed and low genetic potential of indigenous livestock. Though land and consequently feed shortage forced farmers to reduce herd size (Fig. 1), farmers do not have access to improved animals. Lack of forage seed/planting material, lack of appropriate forage species adapted to frost, infertile soil, moisture stress and heavy grazing are specific constraints; 3) Among the six forage development strategies being promoted in Ethiopia, three are being implemented (backyard, forage strip/conservation-based and forage crop –to a limited extent). And yet, the forages developed are not properly used, mainly due to lack of coordination, awareness/knowledge and skill, and low biomass.



Fig. 1 Tethered animals (1 cow & 1 ox) fed with cut-and-carry/zero grazing/stall feeding system

Forage development is not implemented as a package; 4) Among forages grown in nurseries of the study villages, about half are planted by farmers (Sesbania, tree Lucerne, oat, vetch and elephant grass). There is no proof that selection of forage species is based on prescribed protocol, research finding or expert advice; 5) Prohibition of free grazing on communal grazing lands and on land with physical and biological structures is adopted by some communities (eight out of 41 kebeles-in Farta district). In adopter villages, two systems of communal grazing land utilization are emerging: hay making (2x/year) (stall feeding/zero grazing) and daily grazing by limited number of animals (2 animals/household) for limited period of time (3 hours/day) (Fig. 2). Comparative study is commendable! The findings of the study indicate the need for further research on the scientific, socio-economic and institutional aspects of zero-grazing/cut-and-carry/stall feeding systems so that evidence-based transformation of the Ethiopian livestock sector integrated with natural resource conservation can take place!

In addition to the survey study reported above, I submitted seven manuscripts to international journals listed in Web of Science database. Last but not least, fruitful visits were made to research/knowledge institutions (Lanzhou University, China, Tottori prefectural agricultural research centers; Shimane and Hiroshima Universities, NARO Institute of Livestock and Grassland Science and Grassland Science and Tsukuba). Tsukuba).



Fig. 2 Communal grazing land used for hay making (2x per year)

Benjamin Ewa Ubi (Prof., Plant Molecular Biology)

April 2015 – March 2016

DNA marker-aided gene discovery to facilitate the development of high yielding and quality wheat varieties that withstand abiotic stress in a changing climate

1. Construction of a high-density linkage map and mapping of QTLs underlying heading date in the Cs x SHW RILs Population.

I provided guidance for this mapping project involving other team members under the overall direction of Prof. H. Tsujimoto. A total of 18,978 DarT, SNP and MITE markers segregating in a RILs population of 100 individuals were used to construct a high-density genetic map and detect QTLs underlying heading date in this RILs population. Our current map spanning 3,563.6 cM map represents ~70 % coverage of the hexaploid wheat genome estimated at between 2260 – 5332cM (av. 3796 cM) [cf. Cui et al. 2014, BMC Genetics 15: 57] and will serve as a useful tool for the genetic dissection of genes underlying segregating abiotic stresses and other agronomically-important traits. The two parental lines of this mapping population have recently been screened for abiotic stress traits under the guidance of our molecular physiologist, Dr. Okamoto. The two parents and the 107 RILs have been field-grown and will be phenotyped in future efforts for desirable segregating traits.

2. Exploitation of active transposons in wheat and related species

Research efforts were undertaken to explore the active MITEs in wheat and the related species in order to provide insights for their exploitation in wheat molecular breeding. Several identified *stowaway*-like family MITEs were used for genomic studies in wheat; with four MITE markers developed from the preliminary genotyping of our CS x SHW ABD-4 RILs mapping population integrated into our current DarT- and SNP-based linkage map (see above Research Activity 1).

3. Exploitation of MITEs to characterize the biodiversity and evolution of wheat chromosome addition lines

The biodiversity of a total of 155 wheat chromosome addition lines (TACBOW, Tottori Alien Chromosome Bank of wheat supported by NBRP–Wheat) and the background cv. CS, and two wild relatives (*Leymus mollis* and *L. racemosus*) were characterized using 35 DNA markers generated from 12 MITE primer pairs. These addition lines showed wide genetic diversity and were grouped according to their alien chromosome integration. The distribution of insertion sites varied widely especially in the TACBOW lines against the backdrop of their common ancestry from CS suggesting the evolutionary consequences of the alien chromosome integration. The possible association of the loss or gain of insertion sites with variation for plant phenotypic traits needs to be further investigated. A subset of these TACBOW lines had previously been characterized for abiotic stresses such as aluminum and heat stress tolerance. A total of 156 TACBOW lines have been field-planted for evaluation. As a future strategy, it would be worthwhile, therefore, to fully characterize all these TACBOW lines for tolerance to abiotic stresses and further use the already isolated DNA to add more DNA markers (e.g. via transposon display or other high-throughput genotyping platforms) with a view of discovering DNA markers underlying such abiotic stresses.

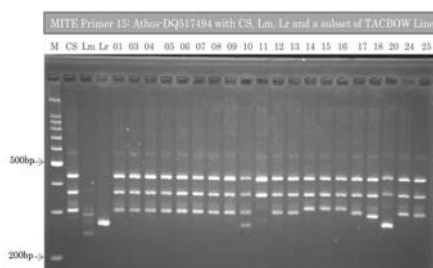


Fig. 1. Transposition of MITE sequence in wheat variety Chinese Spring (CS), *Leymus mollis* (Lm), *L. racemosus* (Lr) and the *Leymus* chromosome addition lines of CS wheat.

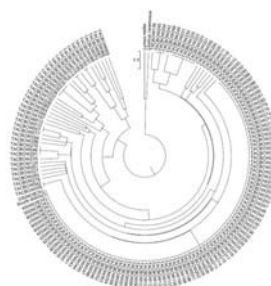


Fig. 2 Dendrogram showing the diversity of alien chromosome addition lines in TACBOW.

Mubarak Abdelrahman Abdalla Ali (Prof., Soil Chemistry)

October 2015- March 2016

Is H-proton release during N-fixation from some tree and shrub legumes can effectively ameliorate calcareous sodic soils

The soil of the experiment (about 200 kg) was supplied by Dr. Tsuneyoshi Endo from the Department of Global Environment Sciences, Faculty of Agriculture, Tottori University. The soil was air-dried for one week, crushed and sieved to pass 2.00 mm sieve (Figure 1). This soil was known as Jagaru in Japanese and collected from the Okinawa Prefectural Kyushu National Agricultural Experiment Station, Okinawa, Itoman city, Makabe 820, Japan. Jagaru is a heavy-textured smectitic soil and shows problematic physical properties such as severe hardening by air-drying. The soil is classified as loamy, siliceous, thermic Typic Udorthents. The initial soil properties were determined after analysis in the Laboratory of Afforestation and Land Conservation Division, ALRC. The soil was made saline-sodic by adding NaCl to raise salinity and SAR to 13.6 dS/m and 20, respectively through 5 cycles of wetting and drying. Finally, the content of CaCO₃ was adjusted to 8% by adding analytical powdered CaCO₃. The characteristics of soil used was determined (The characterization of the soil used in the experiment was determined (pH, ECe, SAR, TC, TN, Ca, Mg, K, CaCO₃, ESP, SP and texture). About 16 lysimeters (11.7 cm internal diameter, 30 cm height) were prepared from Poly Vinyl Chloride (PVC), capped from one side and an opening of one cm diameter was made and a hose of 20 cm was tightly fixed in the hole.

Two racks were prepared to hold the lysimeters and to allow leaching of the lysimeters. A Whatman 42 filter paper was placed at the bottom of each lysimeter and about 2 cm height of acid/distilled water washed sand was added on top of each filter paper. Then after, exactly 3 kg of the saline-sodic soil was added over the layer of washed sand and packed to attain 1.2 g cm⁻³ bulk density by gentle packing to attain 23 cm height. The dormancy of mesquite (*Prosopis glandulosa*) seeds were broken by immersing in boiled water (100°C) for 10 minutes, incubated in moistened Petri-dishes at 35°C for 24 hrs before sowing.

At sowing (9/12/2015), 4 seeds were sown (1 cm deep) in the treatments with mesquite at 0.5 cm depth and soil moisture content was kept at 70% of water holding capacity (WHC) by regular weighing of an extra lysimeter filled with similar soil and packed to the same bulk density. Lysimeters were watered every day and other by adding distilled water to about 75% water holding capacity (Fig. 2).

The plant in each lysimeter will be harvested in 15/05/2016 and will be analyzed for dry matter content, soluble cations (Na, Ca, Mg, K), TN, TC. The soil in each lysimeter will be leached with 1 and 2 pore volume and supernatant will be analyzed for EC, Na, Ca, Mg, K, SAR and hydraulic conductivity.



Fig. 1. Preparation of soil samples

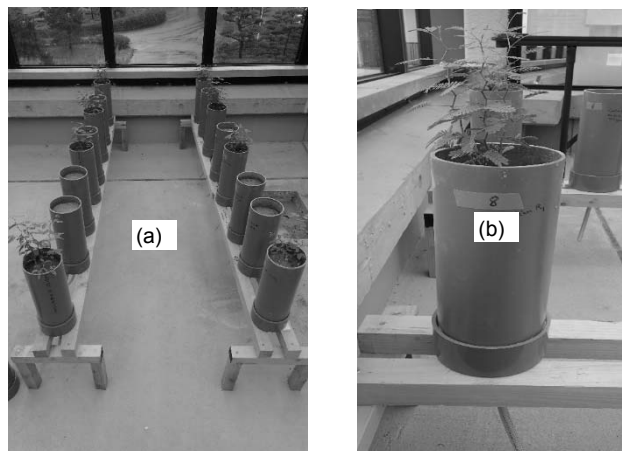


Fig. 2. Lysimeters with mesquite (a) and with leaching tubes (b)

Xinping Wang (Prof., Soil Physics)

October 2015- March 2016

Identification of infiltration process in heterogeneous arid soil

The observational experiment on infiltration processes in the patchy shrub area was carried out in the field by quantifying the spatiotemporal changes in soil water potential, which would be served as a function of hydraulic redistribution resulting from the combined effects of plant water uptake and infiltration in the arid shrubland.

In dry sandy soil, soil water is naturally redistributed by forces owing to matric, gravitational potential, and temperature gradients. Plant roots serve as conduits for water flow not only from soil to leaves but also from wetter to drier soil. This hydraulic redistribution through root systems occurs in soils worldwide and can enhance stomatal opening, transpiration, and plant carbon gain. Hydraulic redistribution through plant roots facilitates movement of water not only upward but also downward and horizontally along moisture gradients within soils, affecting plant physiology, landscape hydrology, and potentially even climate by moving deep water up to dry shallow layers, where it can support enhanced plant transpiration, and by quickly moving precipitation down into deeper soil layers, where it does not evaporate or run off the landscape.

In the present work, diel soil water potential and soil temperature fluctuation was investigated at hourly intervals for a desert shrub land. The fluctuation was compared to natural redistribution of soil water due to thermal gradients at a bare dune site. The variation patterns in soil water potential are caused by unsaturated zone processes, such as soil vapour movement in response to diurnal temperature gradients. This is evidenced by surface soil layer fluctuating between zero and -140 MPa each day. It is likely that the difference in soil water potentials between the shrub and bare sites are due to the organic matter content of the soils at the shrub stabilized dune site, which is absent from the bare dune site. Soil water potential fluctuations reflected daytime depletion and nocturnal resupply of water due to hydraulic redistribution.

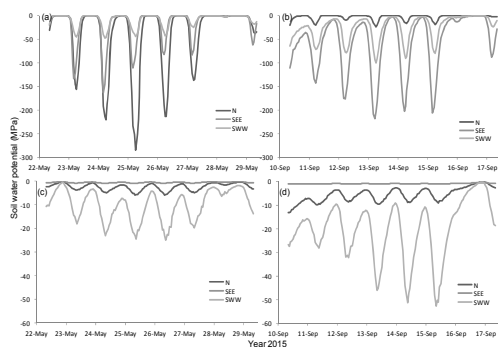


Fig. 1 Comparison of the diel soil water potential variation in N, SEE, and SWW direction under the shrub canopy in May 2015 at 10 cm (a) and 25 cm (c) soil depth and the corresponding of 10 cm (b) and 25 cm (d) soil depth in September 2015, respectively.

A typical spatiotemporal heterogeneity of soil water potential variation was found. The magnitude of daily maximum soil water potential variation exhibited in the directional sequence N, SEE, and SWW at 10 cm depth soil layer. In contrast, it changed to the sequence SWW, N, and SEE at the 25 cm depth, and with a sequence of SEE, N, and SWW at the 75 cm depth at the end of the growing season (Fig. 1). In May, the maximum soil water potential variation at 50 and 75 cm depth was in N and SEE direction, respectively. In September, the maximum soil water potential variation at the 10 cm depth changed from N to SEE direction. The variation of soil water potential may reflect the spatial and temporal distribution of root systems (Fig. 2).

Our work demonstrates that a single point measurement and interpretation of hydraulic redistribution of desert shrub is not enough, and that spatiotemporal heterogeneity of hydraulic redistribution may occur due to the root distribution pattern and the canopy influence on soil thermal status. The hydraulic redistribution displayed a typical spatiotemporal heterogeneity for the desert shrub at the stand scale. Results from this field study indicate that the spatiotemporal heterogeneity of hydraulic redistribution is linked to the patterns of root distribution at different soil layers. This reveals that the root extended into different directions laterally that maximize water use and minimize shrub water stress. The spatiotemporal heterogeneity of hydraulic redistribution reflects the mechanisms underlying the ecological adaptive strategy of the desert shrub.

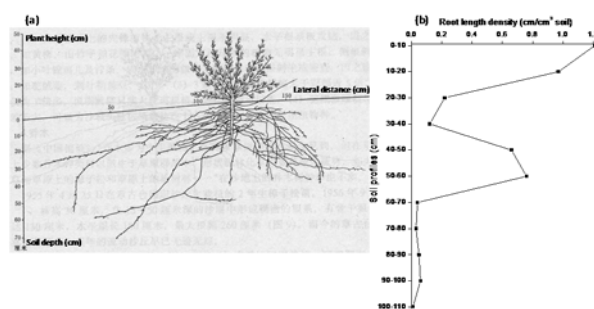


Fig. 2. Root distribution for *A. ordosica* at the experimental area (a, image of root distribution; b, root length density).

(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。

また、文部科学省特別経費事業「限界地プロジェクト」(乾燥地植物資源を活用した天水栽培限界地における作物生産技術の開発—世界の耕作限界地における持続的開発を目指して—)において、年間降水量300ミリメートル台の降雨依存農業地域で、持続的な生産を可能にする農業技術パッケージを作るため、乾燥地植物資源の収集と評価を進めている。

本年度は、以下の研究を進めた。

- メキシコ合衆国において、ジャトロファの収集と植生を調査した。
- ジャトロファの耐寒性系統を作るため、系統を選抜した。
- ソルガムの環境耐性評価を行った。
- 福井ら(大阪大学)と共同で、油料植物の乾燥地での生産性向上に関する研究を行った。
- 近江戸ら(神戸大学)と共同で、早期開花遺伝子を導入したジャトロファに関する研究を行った。



Selection of cold tolerant *Jatropha*

(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.

We are also promoting the MEXT special project "Project Marginal Region Agriculture (Development of crop husbandry technology in marginal rainfed environment using dryland plant resources -Toward sustainable improvement in global marginal regions-)". In this project we are collecting and evaluating of dryland plant resources in order to create an agricultural technology package that enables sustainable production in the regions with about 300 mm annual rainfall.

For the fiscal year 2015, we promoted the following research.

- I investigated collection and vegetation of *Jatropha* in the United Mexican States.
- I selected *Jatropha* plants in order to make the cold-tolerant variety.
- I evaluated environmental tolerance of sorghum.
- In collaboration with Prof. Fukui and others at Osaka University, we did research on improve productivity of oil plants in arid lands.
- In collaboration with Prof. Ohmido and others at Kobe University, we did the study of early flowering transgenic *Jatropha* and flower development.



Seed production of sorghum

妻鹿 良亮 (植物分子生物学)

世界の陸地の約4割が乾燥地であり、年間降水量が少ないために耕作不可能に陥っている乾燥地での耕作を可能にすることは、世界的に逼迫してくる食糧問題の解決に大きく貢献できる。植物の耐乾性の向上はこの問題を解決することができる重要なアプローチの一つである。

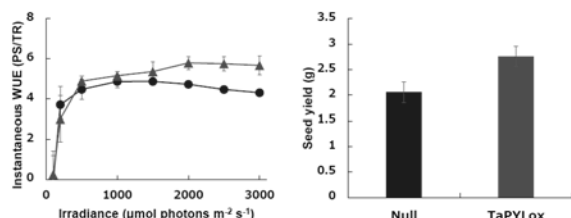
植物の耐乾性にはアブシジン酸 (ABA) が密接に関わっており、ABA 受容体の過剰発現により ABA に対する感受性が高まり、耐乾性が向上する。ABA は植物に普遍的に存在する適合溶質の一つであり、耐乾性作物の創出には ABA 受容体の利用と応用が適していると考えられる。しかし、世界の主要作物の一つであるコムギのゲノムデータベースは未だ十分に整備されておらず、ABA 受容体がほとんど同定されていない。そこで、本研究ではコムギの ABA 受容体 (TaPYL) を同定し、それを過剰発現したコムギ (TaPYLox) を作出した。TaPYL の機能解明により、水の少ない乾燥地でも栽培可能な作物育種への応用も期待される。TaPYL を利用した耐乾性の向上を軸に、乾燥地に適した形質を持つコムギをデザインするため、以下の内容で研究を進めている。

- ・コムギゲノムに存在する TaPYL の探索
- ・生化学的解析による TaPYL の活性の確認
- ・TaPYLox の生理学的解析
- ・TaPYLox のトランスクリプトーム解析
- ・TaPYLox に似た形質を持つ野生品種の探索

本年度は、特に以下の研究で成果を得た。

1. バイオインフォマティクスおよび RACE 法を駆使して9つの TaPYL の同定に成功した。同定された TaPYL の全てが *in vitro* で活性を持つことを生化学的手法により確認した。
2. TaPYLox は ABA に対する感受性が高く、耐乾性が向上していることが生理学的解析により確認できた。
3. 気孔伝導度、蒸散、光合成速度の測定により、TaPYLox は蒸散を抑えつつも光合成速度を維持しており、光合成における水利用効率が向上していることが明らかになった。
4. TaPYLox は水 1L から得られる種子収量が向上しており、植物体においても高い水利用効率を示した。

本研究では、コムギでの TaPYL の過剰発現によって耐乾性の強化だけでなく、水を節約して収量を向上させる効果もあることが実証され、TaPYLox が節水型耐乾性を持つことが示された。



(Left) Instantaneous WUE increased in null segregant (Null, blue) and TaPYLox (red). (Right) Seed yield per 1L of water increased in TaPYLox. These results suggest that TaPYLox obtained highly efficient photosynthesis and water-saving drought tolerance.

Ryosuke Mega (Plant Molecular Biology)

Arid area is known to occupy approximate 40% of land in the world. Improvement of drought stress in plant enables many arid areas due to little rain fall to convert arable in the world. Enhancement of plant drought tolerance can greatly contribute to solve the food problem that is becoming worldwide serious.

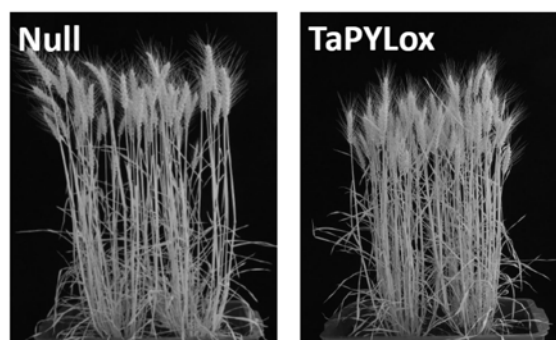
Abscisic acid (ABA) is closely involved in drought tolerance. ABA receptor overexpression improves ABA hypersensitivity to enhance drought stress tolerance of plant. Since ABA receptor exist universally in plant, utilization and application of ABA receptor can contribute to generate drought tolerant crop. Although wheat is one of important staples, few ABA receptors has been identified due to the incomplete genome database. In this study, we characterized wheat ABA receptors (TaPYLs) and generated TaPYL overexpressing wheat (TaPYLox). A set of functional analyses on TaPYLs is expected to be applied to crop breeding to generate cultivar that survive under strict drought environment. We are developing wheat suitable for arid land based on improvement of drought stress tolerance utilizing TaPYL as follows.

- ・ Screening of TaPYL genes of wheat genome
- ・ Biochemical analysis of TaPYLs
- ・ Physiological analysis of TaPYLox
- ・ Transcriptome analysis of TaPYLox
- ・ Search for ABA hypersensitive wild type wheat cultivar

The followings are highlights in this fiscal year.

1. Identification of 9 new TaPYLs by RACE and bioinformatics analysis data. All TaPYLs were confirmed to function *in vitro* by biochemical analysis.
2. TaPYLox showed ABA hypersensitive phenotype and improved drought tolerance by physiological analysis.
3. The data of stomatal conductance, transpiration and photosynthesis demonstrated that TaPYLox sustained photosynthesis although its stomata was closed-prone to save transpiration and instantaneous WUE improved.
4. TaPYLox improved seed yield produced from 1L of water compared with Null, suggesting that TaPYLox showed “water-saving drought tolerance”.

Our research demonstrated that TaPYL overexpression improves not only drought stress tolerance but also water-saving to increase seed yield.



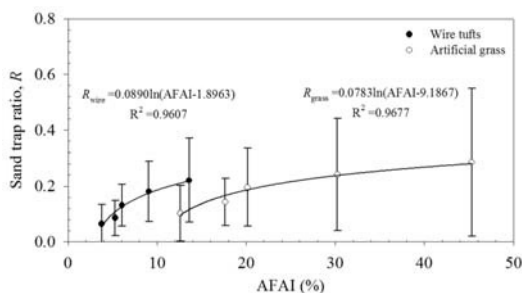
Photograph of ripened Null and TaPYLox. TaPYLox was shorter and more compact than Null.

阿不力提甫 阿不来提 (農業気象学)

東アジアにおける深刻なダストの発生は、局地的な生態系や自然環境、人間社会に対して多大な影響を及ぼすが、それは、発生源の風下に位置する日本や韓国だけではなく、ダストの長距離輸送を通じた北アメリカでも同様である。ダストの発生は、地表面過程、特に土壌水分や植生のバイオマスを決定する過程と密接に関連している。過去の我々の研究では、植生はダスト発生の臨界風速だけではなく、飛砂を捕捉したり、飛砂の衝撃を防ぐ役割を持つことを明らかにしてきた。草本類や丈の短い灌木を含めた植生の前面面積は、飛砂の捕捉に効果があることが分かっており、石や家畜の糞にはそのような効果が認められない。したがって、植生の構造、特に枝葉の柔軟性や間隙率は飛砂を捕捉する際の重要な要素となる。

本研究では、鳥取砂丘や風洞実験において、柔軟性や間隙率に違いを持つ素材を用いて、飛砂の捕捉に対する影響を検討した。2015年度の研究成果は以下のようである。

1. 飛砂の捕捉の比率は AFAI の増加とともに増加したが、AFAI=25% (VC=20%) 以上になると頭打ちになった。乾燥地域においては、植被率が 20%以上あれば、黄砂の発生を防ぐのに効果的であることが示された。(図を参照)
2. 柔軟性のない針金と柔軟性のある人工草の両者ともに、飛砂の沈着は最初の段階では高いが、風下に向かって次第に減少していった。理由として、風上側の針金や人工草に飛砂のほとんどが捕捉され、風下に対する砂の供給が減ってしまったためであると考えられる。
3. 飛砂輸送の比率は AFAI や風速の増加とともに減少した。風に対して柔軟性のない針金は柔軟性のある人工草よりも飛砂の捕捉に対して効果的であることが示唆された。



Relationship between actual frontal area index (AFAI) and sand trap ratio

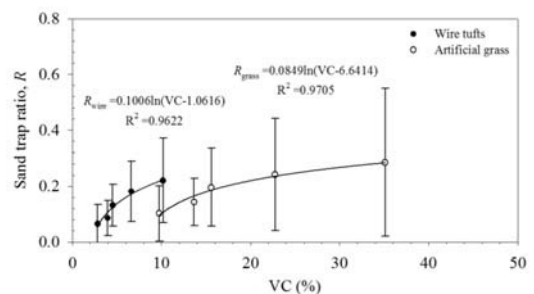
Abulitipu Abulaiti (Agricultural Meteorology)

Severe dust events in East Asia have major effects on local ecosystems, the environment, and human society, as well as large impacts in downwind areas such as Japan, Korea, the North Pacific, and North America through long-range transport. Asian dust can affect the source area, surrounding areas, and the global climate. Dust emission is closely related to land surface processes, in particular to soil hydrological and surface bio-ecological processes which determine the status of soil moisture and vegetation cover. Previous studies found that the vegetation not only can affect the threshold wind speed, but also can trap saltation particles in the shelter area and the saltation bombardment causing dust emission can be reduce. The frontal area was strongly correlated with the shelter length in both short grasses and shrubs, but could not be found in either livestock dung or pebbles. Therefore, the vegetation structure with flexibility and porosity may be important factors for trapping sand.

The purpose of my study is to clarify the effect of actual frontal area with flexible and rigid roughness elements on sand transport by using field observation at Tottori sand dune, and wind tunnel experiment.

In fiscal year 2015, I obtained results as following:

1. Sand trap ratio was increased with AFAI increased, and saturated when actual frontal area index was from 25 % (VC= 20%), which indicates 20% of vegetation cover conditions might be enough for prevent severe dust event in arid region (Fig.).
2. The deposition of both solid wire and artificial grass was initially high and then shows downwind-decreasing, due to decreased sand supply since much of the sand was entrapped by the upwind roughness elements.
3. Sand transport ratio decreased with increasing AFAI and wind speed; and solid wire shows higher effect than artificial grass.



Relationship between vegetation cover (VC) and sand trap ratio

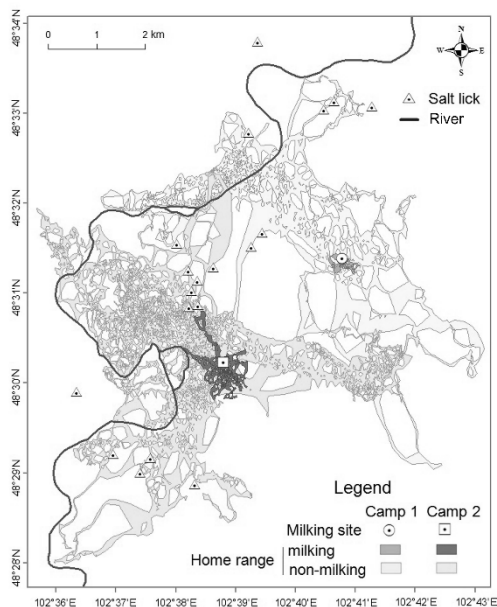
Bat-Oyun, Tserenpurev (農業気象学)

昨年度は、モンゴルの馬乳酒の名産地において、馬乳酒を生産している 60 家族への伝統的知識と方法に関する詳細な聞き取り調査をおこなった。

また、モンゴルの馬乳酒生産のために搾乳されるウマの行動学的研究をおこなった。ウマの管理手法がウマの行動に及ぼす影響を評価するために、馬乳酒の名産地であるモゴドで、2013 年 6 月 25 日から 7 月 15 日 (春営地) にかけてと、7 月 16 日から 9 月 21 日 (夏営地) にかけて実施した、母ウマ 3 頭に GPS を装着した行動追跡と現地環境調査結果の解析をおこなった。仔ウマが搾乳地点付近に繋がれており、母ウマは約 2 時間おきに搾乳のために集められる、日中の搾乳時間帯と、母ウマ、仔ウマとも自由に行動できる夜間の非搾乳時間帯に分けて、母ウマの移動と行動圏を比較した。

調査期間中、母ウマは 07:46 から 15:47 の間に、平均 1.7 時間おきに搾乳のために集められた。追跡した母ウマ個体の動きはほぼ同調しており、1 日の積算移動距離および搾乳地点から移動地点までの最大直線距離は、搾乳時間帯よりも非搾乳時間帯で長かった ($p < 0.01$)。1 日の行動圏面積も搾乳時間帯よりも非搾乳時間帯で大きく ($p < 0.001$)、その差は春営地では 91 倍、夏営地では 26 倍であった。母ウマは春営地での初日を除き毎日、非搾乳時間帯に川を訪れており、非搾乳時間帯に行動圏が大きかったのは、水場や塩場、および食物環境の空間配置を反映していると考えられた。

母ウマは各宿営地での調査開始後から数日は似た範囲を利用したが、数日後から利用場所を変化させた。この変化は、採食により搾乳地点付近での植生量が減少したため、母ウマが離れた地域を利用したことを示唆する。したがって、より良い馬乳酒生産と持続可能な草原利用には、適切な放牧地選びと、宿営地移動時期および搾乳の回数と頻度の選択が重要だろう。



Home ranges of a mother horse during milking and non-milking periods in the Camps 1 and 2.

Tserenpurev Bat-Oyun (Agricultural Meteorology)

In the last fiscal year, a questionnaire survey on detailed traditional knowledge and methods of making fermented horse milk (*airag*) was conducted to 60 herder families who were making *airag* in a famous *airag*-producing region in Mongolia.

In addition, I analyzed movements of mother horses milked for *airag* production in Mongolia. To evaluate the effects of horse management on movement of mother horses we conducted a field survey in a specific *airag* research site located in Mogod, Mongolia (an area famous for producing high-quality *airag*) during 25 June-15 July, 2013 (Camp 1) and 16 July-21 Sep, 2013 (Camp 2). Horse movements and home ranges were compared by GPS tracking of 3 horses for a milking period (baby horses tied to the rope in the milking place from morning to evening, horses graze around milking place and gathered every two hour for the milking) and a non-milking period (horses graze freely with their baby).

Mother horses were gathered every 1.7 h between 07:46 and 15:47 at the milking sites and milked 4.6 times/day during the study period. The tracked mother horses seemed to move together. Daily cumulative and maximum linear distances from the milking sites were longer during the non-milking period than during the milking period ($p < 0.01$). Daily home ranges were 91 and 26 times greater during the non-milking period ($p < 0.001$) in Camps 1 and 2, respectively. The mother horses visited the river every day during the non-milking period except for one day at the beginning of Camp 1. The greater range during the non-milking period would reflect the spatial distributions of water, salt, and forage.

The horses initially used similar areas and gradually shifted their daily home ranges after several days. This shift suggested that the mother horses grazed farther afield as forage availability declined around the milking site. Therefore, for better *airag* production and sustainable pasture use, milking management for selecting suitable sites and choosing the right timing to shift milking sites and appropriate milking times and frequency would be important.



Mother horse with GPS at the milking site.

杉本 太郎 (保全遺伝学)

モンゴルでは 1992 年の自由経済導入後、家畜の数が飛躍的に増加した。家畜の採食量が植物の生産量を上回り、草原の劣化を引き起こす過放牧が現在問題になっている。そこで野生草食動物に対する家畜増加の影響を理解することが求められている。本研究では家畜と野生草食動物の食性に着目し、食性の種間差を明らかにすることを目的とした。本研究では、従来の食性研究で行われてきた顕微鏡を使った糞中未消化物の同定に基づく解析ではなく、次世代シーケンサーを使った糞中植物 DNA に基づく解析を行った。

モンゴル南部で集めた野生草食動物 2 種 (モウコガゼル、アジアノロバ) と家畜 4 種 (ヤギ、ヒツジ、ウマ、ラクダ) の計 6 種の糞を分析した結果、合計 25 科 (39 属、18 種) の植物を同定した。食性の多様性はヤギとヒツジで高かった。ガゼルと食性の重複が高かったのはヤギ、次いでヒツジであった。アジアノロバと食性の重複が高かったのはウマで、次いでヒツジ、ヤギであった。

DNA 配列に基づく解析により、従来の顕微鏡を用いた解析に比べ、より詳細な食性を解明することに成功した。モウコガゼルとヤギ、ヒツジ、およびアジアノロバとウマの間で観察された高い食性重複の要因として、似た体サイズ、および同じ消化システム (反芻動物: モウコガゼル、ヤギ、ヒツジ; 非反芻動物: アジアノロバ、ウマ) が考えられる。一方でアジアノロバはヤギ、ヒツジとも高い重複率を示した。これはヤギ、ヒツジの食性の高い多様性が要因の一つと考えられる。家畜の数の増加はヤギで顕著であり、モウコガゼル、アジアノロバとの資源をめぐる競争が今後より懸念される。本研究は夏に実施したが、資源の乏しい冬ではどのような種間差がみられるのかはまだ分かっていない。種間関係の季節的変化は今後の課題である。



A herder of sheep and goats at a water point where little vegetation was found

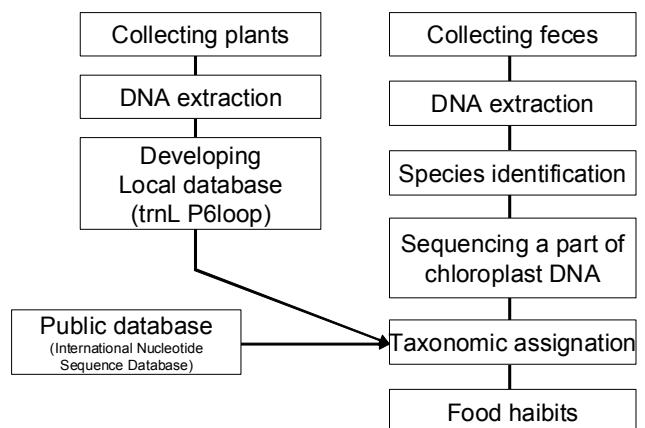
Taro Sugimoto (Conservation Genetics)

The number of livestock such as sheep and goats has been growing in Mongolia during past 20 years. This increase causes reduction of vegetation cover and land degradation in many parts of Mongolia, which is referred to as “overgrazing”. This habitat degradation is likely to pose negative effects toward sympatric wild ungulates such as Mongolian gazelle and Asiatic wild ass. In order to infer the impact of the increasing livestock toward wild ungulates, this study focused on food habits of sympatric ungulates and aimed to examine food overlap between two wild ungulates and four livestock in the dry region in the southern Mongolia. In this study, unlike traditional food habits studies, I identified plant species based on a part of chloroplast DNA sequence obtained from a next generation sequencer.

In total, I detected 25 plant families including 39 genus and 18 species from fecal samples of the six target ungulates. High dietary diversity was observed in sheep and goats. Gazelles had relatively high food overlap with sheep and goats, while wild asses had high food overlap with horses and then with sheep/goats.

DNA based approach using a next generation sequencer successfully identified detailed food habits of six ungulates species. High dietary overlap between gazelles and sheep/goats and between wild asses and horses is likely due to similar body size and the same digestive system (ruminant: gazelle, sheep, goat; non-ruminant: wild ass, horse). High dietary overlap between wild asses and sheep/goats is partially due to higher dietary diversity of sheep and goats. The increase in the numbers of sheep and goats may cause resource competition between sheep/goats and wild ungulates, posing a risk for Mongolian gazelle and wild ass populations.

This study is conducted using samples collected during summer. Food habits in other seasons such as winter, when food resources are limited, need to be studied to infer the seasonal effects on the food overlap among six ungulates.



Methodology for analyzing food habits

石川 智 (地形学)

地形学分野では以下のような研究を行っている。

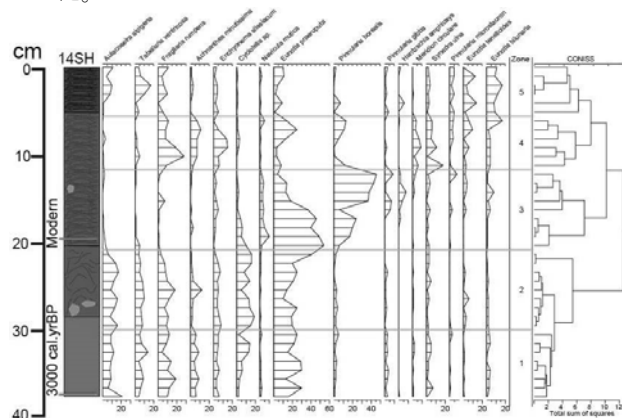
(1) モンゴルの湖沼・沖積平野におけるボーリングコアからの過去約1万年間における4D災害発生史の解明

(2) モンゴルの湿地湖沼における現生珪藻の採取

これらの研究は、文部科学省特別経費事業(黄砂プロジェクト)によって、モンゴルで行われている。

本年度は、特に以下の研究で成果を得た。

- 2014年に採取したモンゴルにおけるボーリングコアの分析を行い、半乾燥域の湖沼沿岸コアからは珪藻が産出せず風食の影響が強いこと、山岳域の湖沼沿岸コアからは過去約3000年の環境変遷を明らかとした。また、CNS分析を行い珪藻の産出しなかったコアについても環境変化とみられる変動をとらえた。
- 2015年夏に2014年と同地域かつ半乾燥域においては珪藻の産出が期待できる、より湖沼の中央に近い地点でボーリング調査を行った。山岳域の湖沼については前年と近い地点のほかその対岸や近隣湖沼においてもボーリング調査を行い、試料を得た。
- ボーリング調査と平行して、モンゴル乾燥域の湖沼・湿原・河川において現生珪藻の採取を行い、試料を得た。



Columnar and diatom diagram of Shireet lake core taken in 2014.

Satoshi Ishikawa (Project Researcher, Geomorphology)

The Geomorphology Subdivision conducts research mainly as follows:

(1) Reconstructions for history of 4D disaster during Holocene from boring core taken in lakes and alluvial plains in Mongolia.

(2) Collections of living diatoms in lakes and rivers in Mongolia.

These studies are conducting under the aid by MEXT Project of Integrated Research (Asian Dust Project).

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

- Wind erosion in semi-arid area are so strong that diatom has not found from boring cores taken in 2014. Environmental changes at mountain lake in center Mongolia was reconstructed for 3000 years. CNS analysis revealed some environmental changes from semi-arid area which has no diatoms in core.
- New boring cores were taken in 2015 near the sites took in last year, which are located inner part of lakes. At the mountain lake, samples were got at more site.
- Samples of living diatoms were got in lakes, marshes and rivers in Mongolia.



Routes of the survey (Aug.8-16, 2015)

モハメド E. E. ハボラ (分子育種学)

干ばつや塩害のような環境ストレスは世界の主要作物の農業生産の制限する要因である。増加する世界の人口のために毎年、食料需要が大きくなっている。植物の干ばつと塩害への耐性を強化し、過酷な環境条件において、より適応できる新品種を開発することは、作物生産を増加させ十分な食糧を確保するために重要である。したがって、有用な耐性遺伝子を単離するための最新のバイオテクノロジーおよびこの技術を分子育種技術によって作物に組換えることは極めて重要である。

この研究は異なる研究者および研究機関との共同研究を含む総合的な方法によって達成できる。特に、乾燥地研究センターはカタール国のカタール大学、米国イリノイ大学アーバナ・キャンペーン校と共同で「干ばつと塩害耐性に関する新奇および独自遺伝子の単離」という課題で国際研究プロジェクトを実施している。このプロジェクトの中で、私は以下の研究を行った。

(1) 乾燥と塩ストレスに対する栽培植物の改良のための近縁野生種ゲノムの遺伝資源の利用。私は、コムギの近縁野生種ハマニンニク (*Leymus mollis*) を用い、それから塩耐性に関与する遺伝子を単離した。この遺伝子は遠縁交雑によってコムギに導入できるので、コムギの塩適応の改善に利用できる。とくに、私は塩耐性の増強に関わる重要な化合物、グリシンベタインの生合成を制御する遺伝子を単離しその特性を調査した。

(2) ハマニンニク染色体添加コムギ系統の乾燥および塩ストレス耐性の評価。

(3) 植物細胞において抗参加物質として働くグルタチオンのリサイクルと再生に重要であるグルタチオン還元酵素を強発現した遺伝子組換えトマトの作製。この組換えトマトの高温及び酸化ストレスに対する反応及び耐性の評価も行った。



Evaluation of heat stress tolerance in transgenic tomato overexpressing glutathione reductase gene.

Mohamed E. E. Habora (Molecular Breeding)

Environmental stresses such as drought and salinity are major limiting factors reducing agricultural production of major crops worldwide. Every year, there is an increasing demand for food to meet the continuous growth of the world population. Enhancing the plants tolerance to drought and salinity and developing new cultivars that are more adaptable to harsh environmental conditions is vital for increasing crop production and securing enough food. Therefore, the use of the modern biotechnologies to clone useful stress tolerance genes, and integrating them into crops via molecular breeding approach is considered of paramount importance.

This could be achieved via integrated approaches including collaboration and engagement between different partners and research organizations. Particularly, the ALRC has a coordinated international research project entitled “Isolation of new and unique genes related to drought and salinity tolerance” carried in collaboration with Qatar University, State of Qatar, and the University of Illinois Urbana-Champaign, USA. Within this project, I carried research on:

(1) Utilization of the genetic resources available in the genome of wild relatives of plants to improve the tolerance of cultivated crops to drought and salinity stresses. I have used the dune grass *Leymus mollis*, a wild relative of wheat, to clone new genes for salt stress tolerance, that could be integrated into wheat via wide-hybridization, and consequently improving wheat adaptation to salinity. Particularly, I have conducted research on cloning and characterization of genes controlling the biosynthesis of glycine betaine, an important compound in the plant cells that enhances the tolerance to salt stress.

(2) Evaluation of drought and salinity stress tolerance of wheat-*Leymus* chromosome addition lines.

(3) Generation of transgenic tomato plant overexpressing glutathione reductase, an important gene to recycle and regenerate the antioxidant glutathione in plant cells. An evaluation of the response and tolerance of the transgenic tomato to heat and oxidative stress has also been carried.

ヤシル・S・A・モハメッド (分子育種学)

優秀なコムギ品種の生殖質は狭まっており、育種に利用することができる新しい遺伝子および形質の発掘が必要である。そのため、実用可能な近縁野生種の遺伝子や形質に注目して研究を行っている。非生物ストレス耐性に関する量的遺伝子のマッピングのための高密度連鎖地図の作成、合成コムギにおける微量元素含量の遺伝的変異の探索、優秀なコムギの遺伝的背景への高温耐性細胞質の導入が本研究の内容である。

1. 春播きコムギ Chinese Spring と合成コムギ系統の交配に由来する 100 の組換え近交系統を用いて、高密度遺伝地図を作成した。この地図は 19015 の DArT-seq、SNPs およびトランスポゾンマーカ―を、平均 0.2 cM に 1 つの割合で含むものである(Fig. 1)。
2. 47 の合成コムギ系統を分析し、この中に鉄および亜鉛含量に関しかなりの遺伝的変異のあることを見出した。そのうち、3 系統は全ての対照品種より、高い鉄と亜鉛を含んでいた。6 つの量的遺伝子を同定したが、そのうち 3 つは高鉄含量に関係し、他の 3 つは高亜鉛含量に関係した。これら 3 系統は、パンコムギの微量元素改良のために有用な資源であることが明らかになった(Fig. 2)。
3. 前の研究で、高温条件下で高い光合成速度を示す細胞質置換系統を見出した。高温条件下で穀物生産を高めまた安定化させることを目的に、これらの系統に 2 系統の優秀なコムギ品種を交配した。耐性細胞質を優秀なコムギの遺伝的背景に完全に導入するために交配を継続予定である。

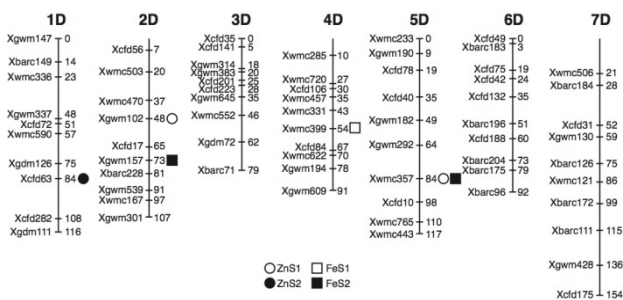


Fig. 2. Genetic map of SSR markers associated with grain Fe and Zn contents in different chromosomes. Chromosome number indicated above; horizontal bars represent loci with associated marker name labeled to the left. S1 and S2 denote the first and second seasons, respectively.

Yasir S. A. Mohammed (Molecular Breeding)

The narrow genetic variation of elite wheat germplasm necessitate exploration of new genes and traits to be used for wheat breeding and improvement. The research activities are focused on utilization of wild relatives' genes and traits for wheat breeding. The research activities included construction of high-density genetic map for mapping QTLs associated with abiotic stress tolerance, exploration of genetic variation for mineral content in synthetic wheat, transfer of heat tolerant cytoplasm to elite wheat genetic backgrounds.

1. A high-density genetic map was developed using 100 recombinant inbred lines derived from a cross between spring wheat genotype Chinese Spring and a synthetic wheat line. The map included 19015 DArT-seq, SNPs and transposon markers with an average density of one marker per 0.2 cM (Fig. 1).
2. We found considerable genetic variation in iron and zinc content among 47 synthetic wheat lines tested. Three synthetic wheat lines showed higher iron and zinc than all the check cultivars. Six QTLs were identified; three were associated with the high iron content, and the other three were associated with zinc content. These three lines are valuable source to improve mineral content in bread wheat (Fig. 2).
3. Previously two cytoplasmic substitution lines with high photosynthesis rate under heat stress were identified. Two elite wheat cultivars were crossed with these lines to transfer the tolerant cytoplasm with the objective of enhancing and stabilizing grain yield under heat stress. The crossing will be continued to transfer the tolerant cytoplasm completely to the elite backgrounds.

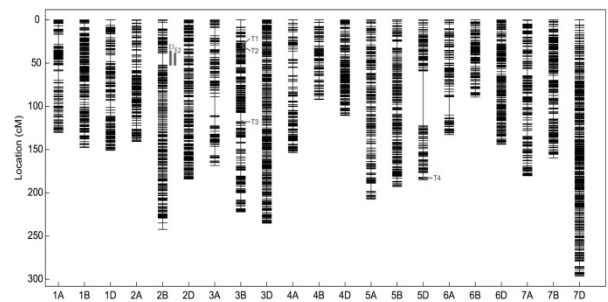


Fig. 1. The constructed linkage map. DArT and SNP markers indicated in black horizontal lines whereas transposon markers indicated in red. The green vertical bars indicate the QTLs of heading date detected in the first (E1) and the second (E2) seasons

金 俊植 (分子遺伝学)

シーケンス技術の発達に伴うレファレンスゲノムの拡充はコムギを始めとする作物の次世代育種技術の開発を促している。本年度では耐乾性コムギ開発に向けた基盤研究として、次世代シーケンス技術(NGS)を活用したコムギのゲノミクス研究基盤確立を執り行った。

- (1) NGS 研究基盤の確立
 - (2) コムギの高密度塩基多型 DB の作製
 - (3) ゲノムワイド関連解析(GWAS)の実施
1. NGS 解析に必要な大型計算システムを導入、必要なパイプラインの構築を完了した。特にパンコムギの巨大なゲノムサイズ (約 170 億塩基、人ゲノムは約 32 億塩基) に特化したシステムを構築することで、コムギを含め巨大ゲノムを持つ作物を対象に柔軟な解析が可能となった。
 2. 複数の共通親を持つコムギ集団 400 系統の NGS 結果の解析を行い、約 60,000 の一塩基多型(SNP)情報を獲得した。さらにこれらの情報を現行のコムギレファレンスゲノム(物理地図)と比較を行うことで、約 15,000 マーカーの物理地図上の位置を決定した。これらの内、約 5,000 マーカーは連鎖地図由来であるため、連鎖地図と物理地図間の統合にアンカーとして役立つ。本段階ではまだマーカー密度が低いものの、今期確立した方法を利用することで、高密度塩基多型 DB 作製が可能となった。
 3. 上記解析から確立した塩基多型 DB を利用して、実際表現型と遺伝子型の関連解析を行った。表現型はスーダン国内の実験圃場から提供された穂の着色データを利用した。解析結果、着色有無と強い連鎖を示す遺伝子座が 1D 染色体の上腕に存在することが明らかになった。本研究の成果は、今後収集される乾燥地におけるコムギの表現型データと合わさって、コムギの耐乾性向上に寄与する遺伝子の探索に重要な足がかりとなる。

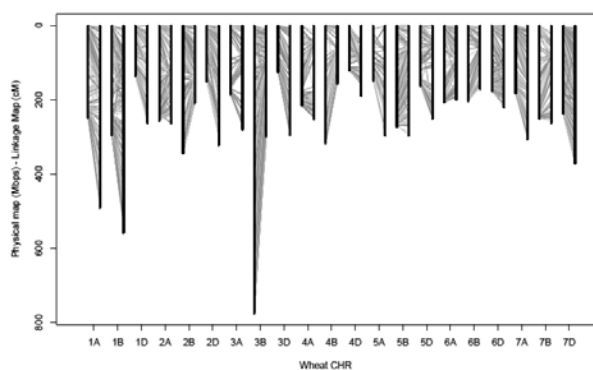


Fig 1. Synteny of wheat linkage map and physical map

Schematic view of wheat chromosomes and relative position of anchoring markers. Left and right vertical bars per each chromosome indicate physical and linkage chromosomes, respectively. Grey bars between two bars present relative position and order of the anchored markers.

June-Sik Kim (Molecular Genetics)

Recent advances in genome sequencing technique have opened new era of crop breeding, allow cost-efficient and limitless development of molecular markers from any valuable crop, including bread wheat. In this fiscal year, I established the next-generation sequencing (NGS)-based marker development pipelines to boost the ongoing breeding progress for drought-tolerant wheat.

- (1) Set up the computation system for NGS analysis
 - (2) Generate high-density single nucleotide polymorphism (SNP) map of bread wheat
 - (3) Genome-wide association approaches to glume coloration
1. Newly high-performance computation system and appropriate pipelines for NGS data analysis have been established, capable to versatile *in silico* approaches especially for bread wheat, which presents a highly complexed and gigantic genome size (17 Gbps, compare to the 3 Gbps genome of human).
 2. More than 60 thousand SNP markers were evaluated from a wheat population of 400 individuals, originated from multiple origins. Among them, 15 thousand markers were located to a unique position of the reference genome, and five thousand markers also have linkage map positions. Using these five thousand markers as anchors, the linkage maps can be converged upon a single physical map (reference genome), which assists to discover the particular genes from genetic linkage data. More marker number is required for reasonable genomic approaches in wheat, thus continuous efforts will be made to enhance the marker development with the guaranteed approaches from this study.
 3. A case study of genome-wide association (GWA) analysis to wheat glume coloration was achieved. The phenotype data has been retrieved from semi-dry field in Sudan. The analysis resulted in single significant peak to 1D chromosome with strong association to the phenotype, which is consistent to previous reports. The peak was detected from both physical and linkage maps at the same position, thus this result will serve as a good case-study for further genomic approaches to drought-tolerant wheat development.

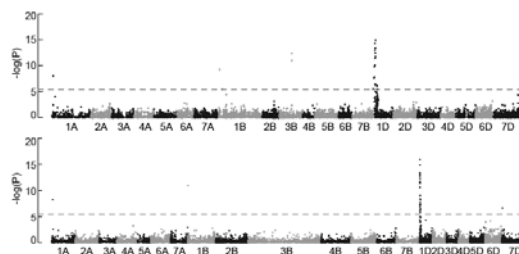


Fig 2. GWA analysis to black glume trait in wheat population

Results of GWA analyses based on linkage map (upper panel) and physical map (lower panel) are presented by manhattan plot. The dashed horizontal line in manhattan plot depicts the Bonferroni-adjusted significance threshold (6.97×10^{-5}).

坂口 巖 (土壌保全学)

2015年11月に乾地研へ異動後、以下の研究を行った。

(1) 中東乾燥地 (ICARDA ムシャカー、ヨルダン) での節水灌漑栽培における灌漑スケジューリングのための、数値解析用パラメタの室内測定。

(2) ヨルダンでの小麦の節水灌漑栽培の実施。

(3) パレスチナ西岸地区 (ラマラ) でのウォーターハーベスティングについての圃場実験に関連する、データ解析用パラメタの室内測定。また現地での、データ回収およびメンテナンスの実施。

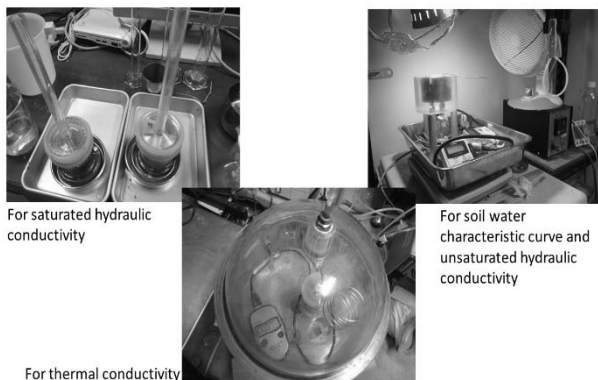
(4) パレスチナ西岸地区 (ジェリコ) での下水処理水を用いた熱帯果樹栽培実験に関連する、データ解析用パラメタの室内測定。また現地での、データ回収およびメンテナンスの実施。

これらについての実施状況を、以下に示す。

(1) については、アンマン南方の都市マダバ近郊にある、ICARDA の小麦圃場で採取された土壌サンプルを用いた。未攪乱状態のサンプルの水利特性パラメタとして、飽和透水係数を変水位法で、不飽和透水係数および土壌水分特性曲線を非定常蒸発法で測定した。その後、水分量を調整したサンプルを所定の密度で充填し、恒温室内で気圧を制御しつつ、サンプルの熱特性パラメタとして熱伝導率を非定常線熱源法で測定した。得られたパラメタを、(2) でのシミュレーションにおいて用いた。

(2) については、2015年11月中旬に ICARDA の小麦圃場で機械播種、灌漑設備の設置、モニタリングセンサの設置を行った。その後2016年3月上旬から、灌漑を開始した。三つの異なる灌漑区 (天水区、自動灌漑区、シミュレーション灌漑区) と、その各々への回復区を一つ設けた。またシミュレーション用パラメタとして、圃場でのアルベドを測定した。

(3) および (4) については、現地で採取された未攪乱状態のサンプルの水利特性パラメタとして、飽和透水係数を変水位法で、不飽和透水係数および土壌水分特性曲線を非定常蒸発法で測定した。また2015年11月中旬および2016年3月上旬に、現地でのデータ回収およびメンテナンスを行った。



For saturated hydraulic conductivity

For soil water characteristic curve and unsaturated hydraulic conductivity

For thermal conductivity

Pictures of measurements of hydraulic conductivity, soil water characteristic curve, and thermal conductivity.

Iwao Sakaguchi (Soil conservation)

After my assignment to the ALRC (Nov. 2015), my research activities are described as follows:

(1) Lab-scale measurement of parameters for simulation of heat and mass transfer in soil which used for the water saving irrigation scheduling at ICARDA Mushaqar, Jordan.

(2) Field experiment of the water saving irrigation of wheat at ICARDA Mushaqar, Jordan.

(3) Lab-scale measurement of parameters to analyze data observed during field experiment of the water harvesting at Ramallah, Palestine. Data collection and maintenance of the experimental system at Ramallah.

(4) Lab-scale measurement of parameters to analyze data observed during field experiment of the cultivation of tropical fruit tree with treated waste water at Jericho, Palestine. Data collection and maintenance of the experimental system at Jericho.

Achievement of each research activity in this fiscal year is described as follows:

(1) Soil samples taken from the wheat field at ICARDA Mushaqar were used for the measurements. As the hydraulic parameters of intact soil, the saturated hydraulic conductivity was measured with falling head method, the unsaturated hydraulic conductivity and soil water characteristic curve were measured with transient-state evaporation method. For the thermal parameter, moisture-adjusted soil samples were packed into container and used for measurement of the thermal conductivity with transient-state line heat source method. Those obtained parameters were used for the numerical simulation included in the research activity (2).

(2) Seeding, settings of irrigation system and monitoring sensors were conducted in mid-Nov. 2015. From early Mar. 2016, the irrigation experiment was started. Three different treatments (Rainfed, Automatic-irrigation, and Simulation-irrigation) and two replicates for each treatment were prepared. As another parameter for the simulation, the albedo of soil surface was measured at ICARDA Mushaqar.

(3) and (4) As the hydraulic parameters of intact soil, the saturated and unsaturated hydraulic conductivity, soil water characteristic curve were measured with the same method applied in the research (1). Data collection and maintenance of the experimental system were conducted in mid-Nov. 2015 and early Mar. 2016 at Ramallah and Jericho.



Picture of field experiment at ICARDA, Mushaqar, Jordan (8th Mar 2016).

(5) 日本学術振興会特別研究員

立石 麻紀子 (樹木生理生態学)

マングローブは熱帯から亜熱帯地域の河口汽水域に広がる樹木郡の総称であり、植物の中でも特に高塩濃度条件下において生育する。そのマングローブ樹木における水利用の定量的評価、生理的特性の解析を通じて、植物の耐塩メカニズムを明らかにすることを目的として研究を行っている。

本研究は、日本学術振興会による科学研究費（課題番号15J07750）の援助によって行われている。

本年度は、以下の通り成果を得た。

1. 分布域の北限に位置する沖縄のオヒルギ、メヒルギにて計測した樹液流速は、ともに観測地の日射量に伴って日変化し、オヒルギがメヒルギの約2倍大きかった。樹液流速には潮汐に伴う水位変動の影響は見られなかった。また、飽差は観測期間を通して日変動が小さいため、飽差よりも日射と良い相関を示した。また、本研究で得られた日単木蒸散量は、既存のマングローブ植物の蒸散量に対して小さかった。
2. また、事前調査で採取したオヒルギ、ヤエヤマヒルギの葉のサンプルにおいて、個葉形態の計測を行った。乾重あたりの葉面積は両者に大きな差は見られなかった。また、乾重あたりの含水率は異なる耐塩メカニズムを持つヒルギダマシに比べると、大きかった。炭素の安定同位体比はメヒルギが一番大きく、オヒルギ、ヤエヤマヒルギの順に小さくなっていった。これまでに、3種の中ではヤエヤマヒルギ、オヒルギ、メヒルギの順に耐塩性が高いと報告されていることから、今回の結果による水利用効率の違いは耐塩ストレスによる違いである可能性が高いと考えられる。



Mangrove forest in Okinawa.

(5) JSPS Fellowship Researcher

Makiko Tateishi (Tree-Eco-physiology)

Mangrove covers brackish-water region in tropical and subtropical area, and grows in high-salinity environment. The physiological characteristics in water use of mangrove trees are investigated to clarify the mechanism of salt tolerance.

This study is conducting under the aid by Japan Society of the Promotion of Science Grants (KAKENHI 15J07750).

In this year, I obtained following results:

1. Water use was monitored in *Bruguiera gymnorhiza* and *Kandelia obovata* growing in Okinawa, which is located in northern limits of its distribution and seems to be in severe environment. Diurnal variation in sap flow was varied with solar radiation, and sap flow of *B. gymnorhiza* was twice as large as that of *K. obovata*. Sap flow was not affected by tidal fluctuation. As VPD had small diurnal variation through the measurement period, sap flow was less correlated with CPD than solar radiation. Water use of individual trees in both species was smaller than that in previous reports.
2. Individual leaf size of *B. gymnorhiza* and *Rhizophora mucronata* in Okinawa was also measured. The leaf area per dry weight of both species were similar. The leaf water contents of both species were larger than *Avicennia marina*, which correlated with different mechanism to salinity. The carbon stable isotope compositions, which is used as an indirect indicator of the water use efficiency, was the highest in *K. obovata* and lowest in *R. mucronata*. This indicates water use efficiency of *R. mucronata* is lower than other species. This result would be corresponded with the differences in the ability of salt tolerance of each species.



Sap flow sensor installed into mangrove trees.

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、文部科学省特別経費事業「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）」を平成23年度から平成27年度まで5年間実施した。

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と、乾燥地の現場と黄砂影響を受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に関する研究を行った。さらに、発生源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った。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工學研究所、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た。プロジェクト最終年度の平成27年度には、これまでの本研究成果の集大成として「黄砂 健康・生活環境への影響と対策（鳥取大学乾燥地研究センター監修 黒崎泰典・黒沢洋一・篠田雅人・山中典和編）」を丸善出版より刊行した。

研究内容

●黄砂発生メカニズムグループ（リーダー：黒崎泰典）

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) Project Asian Dust

ALRC had implemented Project Asian Dust “Assessment and control of dust emission in degraded drylands of East Asia” from FY 2011 through FY 2015, funded by the Ministry of Education, Culture, Sports, Science and Technology (MEXT).

The aim of this project was to elucidate the sandstorm and dust emission mechanisms in the drylands of Mongolia and China, assess the effects of dust on human health, human activities 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 had promoted research in collaboration 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. To finalize the project, ALRC published “Asian dust - effects on human health and environment, and counter measure.” (supervised by ALRC, edited by Y. Kurosaki, Y. Kurozawa, M. Shinoda and N. Yamanaka) by Maruzen Publishing Co. in FY 2015.

Research Summary

● Dust Emission Group (Leader: Kurosaki, Y.)

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) 限界地プロジェクト

栽培限界乾燥地での安定的作物生産を可能にする「植物+栽培技術パッケージ」の開発を目的としたプロジェクト、「乾燥地植物資源を活用した天水栽培限界地における作物生産技術の開発－世界の耕作限界地における持続的開発を目指して－（通称：限界地プロジェクト）」（平成27年度～平成30年度）が文部科学省特別経費事業に採択された。

世界の20%以上の人々が乾燥地で暮らしているが、住民の生活は自然環境の影響を大きく受け脆弱で、貧困、食料不足等、様々な問題に直面している。本プロジェクトでは、生活の基盤である食糧、油糧、飼料作物を対象に、進んだ分子生物学的技術による作物改良と保全型栽培管理技術を合わせることで、年間降水量300ミリメートル代の降雨依存農業地域で、持続的な生産を可能にする農業技術パッケージを作ることに挑戦している。（プロジェクトリーダー：辻本壽）

研究内容

本プロジェクトは、育種研究グループ、栽培研究グループ及び、乾燥地植物資源バンク室の3つのチームで構成されている。

● 育種研究グループ（リーダー：辻本壽）

1. 野生植物の遺伝資源を利用した耐乾性・耐暑性コムギ品種育種のための育種素材の開発
2. 乾燥ストレス応答の分子メカニズムを基盤とした耐乾性油糧作物（ジャトロファ）等の開発
3. 植物ホルモン制御による耐乾性機構の解明と効率的選抜法の開発

● 栽培研究グループ（リーダー：藤巻晴行）

1. 内在菌類・菌根菌感染による作物の耐乾性・耐暑性の付与
2. 乾燥条件下における植物成長モデリング・適正栽培システム構築
3. 乾燥地における持続的草地管理技術の開発
4. 乾燥地における持続的栽培のための効率的な水利用、土壌保全技術の確立

● 乾燥地植物資源バンク室

1. 乾燥地植物資源、植物情報の収集拡大による充実
2. 海外連携機関ジーンバンクとの学術協定

本プロジェクトは、各チームの研究成果等を統合して、乾燥地の農業に有用な技術からなるパッケージを作成する。これまでの乾燥地研究センターにおける共同研究で培われてきた強力な学術及び国際的ネットワークによって本プロジェクトが可能になるものである。

(2) Project Marginal Region Agriculture

ALRC has started a four-year project “Development of Crop Husbandry Technology in Marginal Rainfed Environment Using Dryland Plant Resources - Toward Sustainable Improvement in Global Marginal Regions,” or shortly known as “Project Marginal Region Agriculture,” in FY 2015, funded by the Ministry of Education, Culture, Sports, Science and Technology (MEXT).

Currently, more than 20% of world population lives in dryland regions, and their life faces various difficulties such as poverty and food shortage because their life is fragile and highly affected by natural environment. The challenge of this project is to make an agricultural package to enable sustainable production of food, oil and forage crops that are the base of their life, by combining the techniques of advanced molecular biology and conservation crop cultivation. (Project leader: Tsujimoto, H.)

Contents of the project

This project consists of three research groups (RG); Breeding RG, Husbandry RG, and Laboratory of Arid Land Plant Resources.

● Breeding Research Group (Leader: Tsujimoto, H.)

1. Production of materials for drought and heat stress tolerant wheat breeding by using the germplasm of wild species
2. Production of drought tolerant Jatropha, bio-fuel crop, based on the molecular mechanism of drought response
3. Elucidation of drought tolerance mechanism by plant hormone regulation and development of efficient selection method

● Husbandry Research Group (Leader: Fujimaki, H.)

1. Enhancement of drought and heat stress tolerance by plant-endophyte/mycorrhiza interaction
2. Modeling plant growth under drought condition and development of appropriate crop husbandry system
3. Development of a sustainable grassland management technologies in dryland
4. Development of an efficient water-harvesting and soil conservation system in dryland

● Laboratory of Arid Land Plant Resources

1. Enhancement of dryland plant resources and information
2. Academic agreement with overseas gene banks in the collaborative organizations

Combining the research performances from each group, the project aims at producing a package consisting of technologies that are useful for agriculture in dryland. The secure academic and international network that ALRC has developed through joint and collaborative researches allows smooth implementation of this project.

(3) 日本・アジア青少年サイエンス交流事業 (さくらサイエンスプラン)

乾燥地研究センターでは、国立研究開発法人科学技術振興機構（JST）が実施した平成 27 年度「日本・アジア青少年サイエンス交流事業（さくらサイエンスプラン）」の支援を受け、平成 28 年 2 月 23 日から 3 月 3 日までの 10 日間、中国科学院寒区旱区環境工学研究所（中国）から若手研究者・学生等 10 名を招聘して科学技術交流活動を実施した。

さくらサイエンスプランは、産学官の緊密な連携により、優秀なアジアの青少年が日本を短期に訪問し、未来を担うアジアと日本の青少年が科学技術の分野で交流を深めることを目指して、平成 26 年度から JST が開始。アジアの青少年の日本の最先端の科学技術への関心を高め、日本の大学・研究機関や企業が必要とする海外からの優秀な人材の育成を進め、もってアジアと日本の科学技術の発展に貢献することを目的とした事業である。

乾燥地研究センターと中国科学院寒区旱区環境工学研究所が中心となって実施した本交流活動においては、参加者らと乾燥地研究センターの研究者及び同大学院生との研究発表等を通じた研究交流を行い、研究の相互理解の促進を図った。

また、参加者らは、鳥取県内においては鳥取県農林水産部、砂丘地農業研究センター、北栄町の堆砂垣・静砂垣、鳥取県園芸試験場、殿ダム等を視察し、県内の農業・治水等の取り組みについて理解を深めた。茨城県つくば市においては、国立環境研究所、気象庁気象研究所、農業環境技術研究所、及び国際農林水産業研究センターを視察し、国際的な課題である土地劣化や砂漠化、黄砂等に対する取り組みについて学んだ。



Presentations made by participants from CAREERI

(3) JST Japan-Asia Youth Exchange Program in Science (SAKURA Exchange Program in Science)

During FY 2015, ALRC had carried out an international science and technology exchange activity supported by the Japan-Asia Youth Exchange Program in Science (SAKURA Exchange Program in Science) of Japan Science and Technology Agency (JST). Ten students and researchers from the Cold and Arid Regions Environmental and Engineering Research Institute (CAREERI) of the Chinese Academy of Sciences (CAS), China, were invited to ALRC for ten days from February 23 through March 3, 2016.

SAKURA Exchange Program in Science is the program for enhancing exchanges between Asian and Japanese youths who will play a significant role in the future fields of science and technology through close collaboration of industry-academia-government by facilitating short-term visits of competent Asian youths to Japan. This program aims at raising the interest of Asian youths toward the advanced Japanese science and technologies, fostering superior human resources from overseas who are needed by Japanese universities, research institutions and private companies, and contributing to the development of science and technology of Asian countries and Japan.

During the program, the participants from CAREERI had interacted with researchers and graduate students of ALRC through research workshops and presentations that promoted and deepened the mutual understanding of each other's research activities.

Moreover, in Tottori Prefecture, they visited the Department of Agriculture, Forestry and Fishery, the Horticultural Research Center, and the Sand Dune Agricultural Research Center of the Tottori Prefectural Government, and toured fences for heaping and controlling sand placed on the seashore of Hokuei-town and the facilities of Tono Dam that helped them deepen their understanding of the measures of prefecture's agriculture and water control. In Tsukuba City, Ibaraki Prefecture, they visited the National Institute for Environmental Studies, the Meteorological Research Institute, the National Institute for Agro-Environmental Sciences, the Japan International Research Center for Agricultural Sciences (JIRCAS). During the visits, they learnt Japan's efforts to tackle such global issues as land degradation, desertification, and Asian dust.



Visit to the Horticultural Research Center

1.3 共同研究/ Joint Research

(1) 特定研究 / Specific Research

特定研究 1 Specific Research 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	油料植物の乾燥地での生産性向上：形質転換植物作製、DNA マーカーを用いた系統選抜、および環境再現装置を用いたそれらの耐環境ストレス能の評価 Improve productivity of oil plants in arid lands: Production of genetically-engineered plants, selection by DNA markers, and evaluation of their stress tolerance by 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) 土本 卓 (大阪大学工学研究科) 酒井 啓江 (大阪大学工学研究科) 安藤 孝之 (鳥取大学国際交流センター) 勝浦 千瑛 (大阪大学工学研究科) 辻 涉 (鳥取大学農学部) 留森 寿士 (鳥取大学乾燥地研究センター) 井上 知恵 (鳥取大学乾燥地研究センター) イズマイル アーメド モハメド (大阪大学工学研究科) アルフレド ザマリパ コルメネロ (INIFAP,CIRPAS) ビクター ペシナ キンテロ (INIFAP,CIRCE) ホセ ルイス アナヤ ロペス (INIFAP,CIRCE) 和田 直樹 (大阪大学工学研究科) 李 海燕 (大阪大学工学研究科) レオバルド イラチェタ ドンファン (INIFAP,CIRPAS) ホセ ルイス ソリス ボニリャ (INIFAP,CIRPAS) 養手 佑尚 (大阪大学工学部) 原田 久也 (大阪大学工学研究科) Tsujimoto, Hisashi (Arid Land Research Center, Tottori University) Tsuchimoto, Suguru (Graduate School of Engineering, Osaka University) Sakai, Toshie (Graduate School of Engineering, Osaka University) Ando, Takayuki (Center for International Affairs, Tottori University) Katsuura, Chiaki (Graduate School of Engineering, Osaka University) Tsuji, Wataru (Faculty of Agriculture, Tottori University) Tomemori, Hisashi (Arid Land Research Center, Tottori University) Inoue, Tomoe (Arid Land Research Center, Tottori University) Ismail Ahmed Mohammed (Graduate School of Engineering, Osaka University) Alfredo Zamarripa Colmenero (INIFAP, CIRPAS) Víctor Pecina Quintero (INIFAP, CIRCE) José Luis Anaya López (INIFAP, CIRCE) Wada, Naoki (Graduate School of Engineering, Osaka University) Li, Haiyan (Graduate School of Engineering, Osaka University) Leobardo Iracheta Donjuan (INIFAP, CIRPAS) José Luis Solís Bonilla (INIFAP, CIRPAS) Minote, Yutaka (Faculty of Engineering, Osaka University) Harada, Kyuya (Graduate School of Engineering, Osaka University)	
共同研究要旨 Summary of Joint Research	<p>Transgenic jatropha overexpressing the JcNF-YB1 or JcPPAT gene were transferred to Arid Land Research Center, and their drought tolerance were compared with non-transgenic jatropha in the Dry-land Simulation System. After 14 days treatment without watering, plants were re-watered for recovery. We found that photosynthesis rate and stomatal conductance were significantly higher in JcNF-YB1 transgenic plants than non-transgenic plants at the recovery stage. This suggests that JcNF-YB1 transgenic plants are superior in recovery from the drought stress. The jatropha JcNF-YB6 gene was introduced in Arabidopsis, and expression of the transgene was detected by RT-PCR. We also introduced the spinach BADH gene that encodes the enzyme for glycine betaine synthesis to jatropha. Transgenic Arabidopsis plants expressing the jatropha ABC transporter gene JcABCG25 were produced, and stomata closure in the transgenic plants was suggested from their higher leaf temperature and lower stomatal conductance than non-transgenic plants.</p> <p>Association analysis of jatropha was performed, and DNA markers significantly associated with yield-related traits were identified. We collected jatropha samples from the Altos region of Chiapas and the Tabasco state, and did marker analysis. Genetic diversity in Altos was as high as central Chiapas, and that of Tabasco was the same as other states neighboring to Chiapas. Only group A jatropha existed in Altos, and on the other hand, jatropha of all groups existed in Tabasco. We also detected polymorphism in the marker analysis of jojoba, but the frequency seemed to be lower than jatropha.</p>	

特定研究 2 Specific Research 2	対応教員 Corresponding Staff	辻本 壽 Tsujimoto, 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	乾燥地の植物遺伝資源を利用した環境ストレス耐性の機構解明ならびに育種利用 Mechanisms of abiotic stress resistance in the arid-land plant genetic resources	

研究分担者 Co-researchers	加藤 敦司 (鳥取大学大学院連合農学研究科) ゴイツェオン マランバン (鳥取大学大学院連合農学研究科) 内田 美音 (鳥取大学農学研究科) 大塚 未貴 (鳥取大学農学研究科) 金谷 潤宏 (鳥取大学農学研究科) アミン・エルサディグ (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) 辻 渉 (鳥取大学農学部) 岡本 昌憲 (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) 恒川 篤史 (鳥取大学乾燥地研究センター) Kato, Atsushi (The United Graduate School of Agricultural Sciences, Tottori University) Goitseone, Malambane (The United Graduate School of Agricultural Sciences, Tottori University) Uchida, Mio (Graduate School of of Agricultural, Tottori University) Ohtsuka, Miki (Graduate School of Agriculture, Tottori University) Kanaya, Mitsuhiro (Graduate School of Agricultural, Tottori University) Eltayeb Habora, Amin Elsadig (Arid Land Research Center, Tottori University) Tomemori, Hisashi (Arid Land Research Center, Tottori University) Tsuji, Wataru (Faculty of Agriculture, Tottori University) Okamoto, Masanori (Arid Land Research Center, Tottori University) Ando, Takayuki (Center for International Affairs, Tottori University) Tsunekawa, Atsushi (Arid Land Research Center, Tottori University)
共同研究要旨 Summary of Joint Research	<p><i>Jatropha</i> (<i>Jatropha curcas</i> L) is a perennial shrub with moderate drought resistance, and produces seed oils suitable for biodiesel fuel. Previous studies have reported that <i>Jatropha</i> tolerate heavy metal-polluted soils, suggesting the potential dual uses of this plants for renewable energy production and phytoremediation. However, physiological responses of this plant to heavy metals are largely uncharacterized. In this study, physiological responses of <i>Jatropha</i> seedlings to five representative heavy metals (Cd, Cr, Cu, Ni and Zn) were examined in a hydroponic culture. Increased concentration of each heavy metal, particularly of Cu and Ni, led to severe growth retardation. Content of accumulated heavy metals were higher in Cr-, Zn- and Cd-treated plants, and the applied metals were preferentially accumulated in the roots. In Cd-treated plants, decrease in the leaf transpiration rate and photosynthesis activity was observed, which was accompanied with a decrease of Fe content in the leaves and Mn content in the roots. An increase in the thiol compounds was observed in the roots of Cd-treated plants, suggesting a defensive response of <i>Jatropha</i> to cadmium exposure.</p> <p>To improve the productivity of <i>Jatropha</i>, it is important to understand the molecular functions of key genes in <i>Jatropha</i>, and to seek ways to modify important agronomic traits of <i>Jatropha</i> via molecular breeding. Vacuum infiltration of an <i>Agrobacterium</i> suspension with <i>Jatropha</i> explants, combined with co-cultivation on filter-paper wicks moistened with co-culture medium instead of on solid medium, significantly improved transformation efficiency. Moreover, a variant of the yellow fluorescent protein gene, Venus, was used as a visible marker, which proved effective for prompt selection of candidate transgenic shoots from escape shoots. Transgenic <i>Jatropha</i> plants were self-pollinated, and T1 seeds were obtained. Transmittance of the transgene was confirmed by Venus fluorescence, demonstrating the stability of the transformation.</p>

特定研究 3 Specific Research 3	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	パレスチナにおける下水処理水および脱塩処理水を利用した熱帯果樹栽培 Tropical fruit tree cultivation using sewerage treatment water and desalination processing water in Palestine	
研究分担者 Co-researchers	田村 文男 (鳥取大学農学部) 恒川 篤史 (鳥取大学乾燥地研究センター) 辻本 壽 (鳥取大学乾燥地研究センター) 田川 公太郎 (鳥取大学地域学部) 松本 和浩 (弘前大学農学生命学部) Tamura, Fumio (Faculty of Agriculture, Tottori University) Tunekawa, Atsushi (Arid Land Research Center, Tottori University) Tsujimoto, Hisashi (Arid Land Research Center, Tottori University) Tagawa, Kotaro (Faculty of Regional science, Tottori University) Matsumoto, Kazuhiro (Faculty of Agriculture and life science, Hirosaki University)	
共同研究要旨 Summary of Joint Research	As a waste water treatment plant (WWTP) has been newly constructed in Jericho under Japan-Palestine economic cooperation, it is timely for researchers from Japan and the National Agricultural Research Center of Palestine to conduct an experiment to explore potentials of the use of this unconventional water resource for agriculture. The specific objective of this study is to measure water	

	<p>requirements and find optimum trigger suction values for automatic irrigation system for tropical fruit trees using treated waste water in the study area.</p> <p>Two treatments, differing in trigger suction value for automatic irrigation system, was settled, where each treatment have 2 replicates in the land of Jericho WWTP. Four mango trees and four guava trees was transplanted in each treatment row in December, 2014. Irrigation method is drip irrigation with button emitter and controlled by tension-meter automatically. Meteorological factor to determine ETp is measured. Salinity level of treated water was 2mS/cm. The system is working successful on the whole.</p> <p>Sap flow measurements with Heat Ratio Method on Mango and Guava stems were conducted in the plot and calibrated at Minami Kyushu University. The diurnal curve of sap flow on the Mango stem was indicated slight water stress condition in the plot and verified with water stress experiment. Non-reduced seasonal sap flow data obtained during very hot summer in Jericho, except the water transport trouble, indicates the possibility of the outdoor cultivation of tropical fruits using treated waste water. It is also revealed that HRM has measuring upper limitation value around 27cm/h in the case of Guava seedling. Salinity tolerance is also evaluated for Guava and it is not sensitive up to 5000ppm. Additionally, we examined the automatic irrigation system based on sap flow system against a potted mango plants applying saline water. Measured relatively high heat pulse velocity was utilized for the criteria of irrigation with three stages.</p>
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特定研究 4 Specific Research 4	対応教員 Corresponding Staff	黒崎 泰典 Kurosaki, Yasunori
研究代表者 Principal Researchers	石塚 正秀 (香川大学工学部) Masahide Ishizuka (Faculty of Engineering, Kagawa University)	
研究課題 Research Subject	モンゴル現地実験と冷涼帯砂漠シミュレータによる土壌表層のクラスト形成過程の解明 Study on soil crust formation by field experiment in Mongolia and dryland simulation systems for cold desert	
研究分担者 Co-researchers	西原 英治 (鳥取大学農学部) 中村 公一 (鳥取大学工学研究科) ガンツチェチェック バットデルガー (モンゴル気象水文環境研究所) 山田 豊 (理化学研究所光量子工学研究領域) デュラム ジュグデル (モンゴル気象水文環境研究所) Dulam Jugder (IMHE) 三上 正男 (気象庁気象研究所) Nishihara, Eiji (Faculty of Agriculture, Tottori University) Nakamura, Koichi (Graduate school of Engineering, Tottori University) Gantsetseg Batdelger (Environmental Research Section, IMHE) Yamada, Yutaka (Center for Advanced Photonics, RIKEN) Dulam Jugder (Environmental Research Section, IMHE) Mikami Masao (JMA/MRI)	
共同研究要旨 Summary of Joint Research	This study tries to make soil crusts for sand, sandy loam and silt loam by using an artificial rainfall generator and a weather chamber (owned by Tottori University). Soil crust was not formed for sandy soil. The crust was formed for silt loam but the cracks generated along the wall of the soil container, and some cracks were formed in the center of the container. On the other hand, cracks for sandy loam were certainly formed in the center of the container for all conditions and the area size of cracks was bigger than that of silt loam. Under the diurnal variations of sunlight and temperature-humidity in the chamber, the crack area of sandy loam, which does not include gravels, became bigger than that under the constant sunlight and temperature-humidity conditions. This result shows that the variation and the taking sunlight and temperature-humidity into account were important to reproduce the soil crust. In addition, a crack area ratio became bigger when as a result of large rain amount. From this result, it was shown that the rainfall amount is important for the size of cracks. In addition, the difference in crack area ratio depending on the experiment conditions was not observed for sandy loam with gravels.	

特定研究 5 Specific Research 5	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) Kashiwagi, Junichi (Graduate School of Agriculture, Hokkaido University)	
研究課題 Research Subject	中国極乾燥地民勤オアシスにおける環境保全型農業の生産性向上に関する研究 Study for agricultural productivity improvements based on environmentally-friendly farming systems in arid oasis, Minqin in China	

研究分担者 Co-researchers	<p>岡元 英樹 (北海道立総合研究機構農業研究本部上川農業試験場天北支場) 井上 知恵 (鳥取大学乾燥地研究センター) 王 涛 (中国科学院蘭州分院) 黄 翠華 (中国科学院寒区乾区環境および工程研究所) 薛 嫻 (中国科学院寒区乾区環境および工程研究所) 陳 国雄 (中国科学院寒区乾区環境および工程研究所) 張 金林 (蘭州大学草地農業科技学院) 崎原 麗霞 (鳥取大学国際交流センター)</p> <p>Hideki, Okamoto(Hokkaido Research Organization, Kamikawa Agricultural Experiment Station, Tenpoku Sub-station) Tomoe, Inoue (Arid Land Research Center, Tottori University) Tao Wang (Lanzhou Branch, Chinese Academy of Sciences)</p> <p>Cuihua Huang (Cold and Arid Regions Environmental and Engineering Research Institute, Chinese Academy of Sciences) Xian Xue (Cold and Arid Regions Environmental and Engineering Research Institute, Chinese Academy of Sciences) Guoxiong Chen (Cold and Arid Regions Environmental and Engineering Research Institute, Chinese Academy of Sciences) Jinlin Zhang (College of Pastoral Agriculture Science and Technology, Lanzhou University) Reika Sakihara (Center for International Affairs, Tottori University)</p>
共同研究要旨 Summary of Joint Research	<p>The objective of this project was to develop pro-environments and sustainable agricultural systems in drying oasis, Minqin, China. Major progress were described below.</p> <ol style="list-style-type: none"> 1. In wheat cultivation, the results showed that relative importance on the transpiration use efficiency became relevant under severe drought environments rather than the total transpiration itself. This may indicate that the aggressive soil water uptake is not necessary for the reasonable wheat productions in the arid environments. 2. In salinity tolerance studies for indigenous plants, <i>Lycium ruthenicum</i> and <i>Kalidium foliatum</i>, they showed better plant growth under higher saline conditions. The results indicate that their root systems played an important role to make it. 3. In fodder sorghum cultivation fields, unique salinity distributions in the soil profile was observed. It seemed to influence the ash contents and buffering abilities in the sorghum plants, which may decline the quality when they were used as animal feed silage.

特定研究 6 Specific Research 6	対応教員 Corresponding Staff	エルタイプ・アミン Eltayeb Habora Amin
研究代表者 Principal Researchers	岩田 洋佳 (東京大学大学院農学生命科学研究科) Iwata, Hiroyoshi (Graduate School of Agricultural and Life Sciences, Tokyo University)	
研究課題 Research Subject	スーダンにおける作物生産性向上を目指したソルガムのステイ・グリーン形質のゲノム情報学的研究 A genome informatics study of the sorghum stay-green trait for improving crop production in Sudan	
研究分担者 Co-researchers	<p>鐘ヶ江 弘美 (東京大学大学院農学生命科学研究科) 南川 舞 (東京大学大学院農学生命科学研究科) 田中 凌慧 (東京大学大学院農学生命科学研究科) 青池 亨 (東京大学大学院農学生命科学研究科) 服部 智宏 (東京大学大学院農学生命科学研究科) 堀 智明 (東京大学大学院農学生命科学研究科)</p> <p>Kanegae, Hiromi (Graduate School of Agricultural and Life Sciences, Tokyo University) Minamikawa, Mai (Graduate School of Agricultural and Life Sciences, Tokyo University) Tanaka, Ryokei (Graduate School of Agricultural and Life Sciences, Tokyo University) Aoike, Toru (Graduate School of Agricultural and Life Sciences, Tokyo University) Hattori, Tomohiro (Graduate School of Agricultural and Life Sciences, Tokyo University) Hori, Tomoaki (Graduate School of Agricultural and Life Sciences, Tokyo University)</p>	
共同研究要旨 Summary of Joint Research	<p>Genome-wide DNA polymorphisms of four Sudanese cultivars, Tabat, Gadambalia, AG8, and Abu70, were detected with whole genome resequencing analysis. Gadambalia and AG8 are rain-fed drought tolerant cultivars, Tabat is an irrigated drought sensitive, while Abu70 is moderately tolerant. Genomic admixture analysis of the four cultivars with publicly available genomic sequences of 44 sorghum accessions suggested the existence of three major subpopulations. Over half of genome of Abu70 has a background closely related to wild related species. Of the detected DNA polymorphisms, ca. 3000 for each line were predicted to have strong effect on gene functions, most of which were related to stress tolerance. Through the analysis, we found that one-third of the sorghum genome has scarce historical recombinations. This discovery is important in estimating the genetic background and relationship of sorghum germplasm. Frequency of historical recombinations was closely related to gene density in each genomic region, suggesting the potential of weighting SNPs with the gene density to estimate accurate genetic relationships among cultivars. To develop a high-throughput method for</p>	

	evaluating the stay-green trait in sorghum, we devised a new ad-hoc index calculated from an image taken by a near-infrared camera. Because a near-infrared camera can be mounted on a drone, it is considered to be effective in assessing the stay-green trait of a large number of plants in a field. Using the bilateral joint research projects/seminars project with Sudan, we exchanged the information about current researches and discussed future research plans with Agriculture Research Corporation (ARC), Sudan. The present study can be extended to a study to exploit useful and rich genetic variations harbored by Sudanese germplasm for genomic assisted breeding in sorghum.
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(2) 一般研究 / General Research

一般研究 1 General Research 1	対応教員 Corresponding Staff	木村 玲二 Kimura, Reiji
研究代表者 Principal Researchers	田川 公太郎 (鳥取大学地域学部) Tagawa, Kotaro (Faculty of Regional Sciences, Tottori University)	
研究課題 Research Subject	太陽光発電によるポンプ揚水と節水灌漑を融合した省資源型作物栽培システムの最適設計 Optimal design of sustainable crop cultivation combing the water saving irrigation with photovoltaic water pumping system	
研究分担者 Co-researchers	藤巻 晴行 (鳥取大学乾燥地研究センター) 五百井 拓哉 (鳥取大学大学院地域学研究科) 鶴浩太 (鳥取大学地域学部) Fujimaki, Haruyuki (ALRC, Tottori university) Ioi, Takuya(Graduate School of Regional Sciences, Tottori University) Tsuru, Kota (Faculty of Regional Sciences, Tottori University)	
共同研究要旨 Summary of Joint Research	<p>The goal of this study is to develop the power generation and water supply system by renewable energy utilization for crop cultivation in dryland. In this study, the developed system was composed of stand-alone type photovoltaic (PV) module, battery system, storage pump, and drip irrigation system. The field experiment of the prototype system has been carried out to suggest the practical design of the system at the coastal sand dune in Arid Land Research Center of Tottori University. The following results were obtained from the experiment.</p> <p>(1) The ratio of the power consumption of pump operation to power generation of PV module was 50% in the case of using the electricity supplied by PV module and battery system for pumping the coastal groundwater.</p> <p>(2) The storage coastal groundwater was supplied to the greenhouse in order to irrigate for the cultivation of Swiss chard for from May to September in 2015. It was proved that the system developed in this study was capable to supplying to the drip irrigation for Swiss chard cultivation with irrigated area of 30m². It was also found that the amount of harvested Swiss chard per irrigated water of 1m³ was 20kg in this experiment.</p> <p>(3) The power generation cost and water pumping cost were calculated to estimate the cost effectiveness of this system. It was found that the power generation cost was 0.44 US\$/kWh and the water pumping cost was 12.2 US\$/m³. Though the water pumping cost got expensive in this experimental condition, it is possible to reduce the water pumping cost by the operation of water pumping with the maximum performance of the pump.</p> <p>(4) From these results, it is possible to suggest the method for the practical design of the developed system.</p>	

一般研究 2 General Research 2	対応教員 Corresponding Staff	黒崎 泰典 Kurosaki, Yasunori
研究代表者 Principal Researchers	長田 和雄 (名古屋大学大学院環境学研究科) Osada, Kazuo (Graduate School of Environmental Studies, Nagoya University)	
研究課題 Research Subject	鳥取に飛来・沈着する黄砂の観測 Observation of deposition and transportation of Kosa at Tottori	
研究分担者 Co-researchers	長島 佳菜 (海洋研究開発機構地球環境変動領域) 山中 典和 (鳥取大学乾燥地研究センター) Nagashima, Kana (Research Institute for Global Change, JAMSTEC) Yamanaka, Norikazu (ALRC, Tottori university)	
共同研究要旨 Summary of	Location of ALRC building has the geographical advantage to obtain various atmospheric samples such as Asian dust (Kosa) particles and others transported from far west where air pollution is severe.	

Joint Research	<p>In this fiscal year, we conducted 1) analysis on Asian dusts obtained from May 26 to June 2, 2014, 2) measurements of PM10 and PM2.5 by an automated instrument at the roof of the main building, and 3) measurements of NH3 and SO2 concentrations to study transboundary air pollution. Volume size distribution of dry deposition particles during a Kosa event (5/25-6/2, 2014) showed changes from a broad peak around 40 μm at the beginning to a narrow peak around 15 μm in diameter at the end of period. These particles are composed of quartz, albite, anorthite, chlorite, and illite, with the quartz crystallinity value from 8 to 9. These characteristics are well correlated with the Asian dust sources, such as the Gobi Desert in southern Mongolia and the Taklimakan Desert.</p> <p>Size-segregated tape filter samples for Kosa events in 2015 were also analyzed for major ionic constituents to study nutrient (such as NO3-) transport with Asian dust.</p>
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一般研究 3 General Research 3	対応教員 Corresponding Staff	黒崎 泰典 Kurosaki, Yasunori
研究代表者 Principal Researchers	牧 輝弥 (金沢大学理工研究域) Maki, Teruya (College of Science and Engineering, Kanazawa University)	
研究課題 Research Subject	ゴビ砂漠から風送されるバイオエアロゾルにおける微生物群の実相調査 Investigation of airborne microbial communities in bioaerosol transported from Gobi Desert	
研究分担者 Co-researchers	篠田 雅人 (鳥取大学乾燥地研究センター) 山中 典和 (鳥取大学乾燥地研究センター) 大西一成 (鳥取大学医学部) 谷口 武士 (鳥取大学乾燥地研究センター) 原 和崇 (金沢大学環日本海域環境研究センター) Shinoda, Masato (ALRC, Tottori university) Yamanaka, Norikazu (ALRC, Tottori university) Onishi, Kazunari (Faculty of Medicine, Tottori university) Taniguchi, Takeshi (ALRC, Tottori university) Hara, Kazutaka (Institute of Nature and Environmental Technology, Kanazawa University)	
共同研究要旨 Summary of Joint Research	<p>Asian dust (Kosa) events transport airborne microorganisms that significantly impact biological ecosystems, human health, and ice-cloud formation in downwind areas. However, the composition and population dynamics of airborne bacteria have rarely been investigated in downwind areas during Kosa events. In this study, air samplings were sequentially performed at the top of a 10-m high building within the Kosa event arrival area (Souel city, Koria and Yonago city, Japan) from March to June 2015, when aerosols were transported from Chinese desert regions. The particle concentrations of bacterial cells and mineral particles increased ten to one hundred times during the dust or air-pollution events as compared to normal days. MiSeq sequencing analysis targeting 16S rDNA sequences prepared from the air samples primarily contained sequences from three phyla: Cyanobacteria, Firmicutes, and Proteobacteria. The sequences of Cyanobacteria were mainly from a marine type of Synechococcus species that was dominant after April, suggesting that marine bloom microalgae would be transported from the Sea of Japan and the continental area of China. The sequences from Proteobacteria were mainly detected at non-dust and non-air pollution event. During the dust event, the Firmicutes mainly including family Bacilli were predominant; these species are known to be predominant in the atmosphere above the Chinese desert, which is the source of the dust during dust events. Our results suggest that airborne bacterial communities at the ground level in areas affected by dust and air-pollution vents change their species compositions containing terrestrial and pelagic bacteria transported from the Sea of Japan and the continental area of China.</p>	

一般研究 4 General Research 4	対応教員 Corresponding Staff:	恒川 篤史 Tsunekawa, Atsushi
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に関する研究ーオーストラリアを事例としてー Economic Development and its Character in Arid Land-The Case of Cities in Australia-	
共同研究要旨 Summary of Joint Research	<p>Economic development and its character of arid cities in Australia.</p> <p>The objective of this study is to clarify the dynamism of economic development and the factor of developing in cities where are located in arid environments. At first, the cities in Australia were classified based on the natural environment the economic environment, the social environment and so on. The result showed that most of arid cities have located and developed in the Western</p>	

	Australia State, the South Australia State and the Northern Territory State. Secondly, the developed and developing cities in arid land were extracted. The result from analysis of economic data showed economic dynamism and development of industries in each arid city. After that, we will try to clarify the factor and the mechanism of economic development in arid cities.
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一般研究 5 General Research 5	対応教員 Corresponding Staff	恒川 篤史 Tsunekawa, Atsushi
研究代表者 Principal Researchers	山下 博樹 (鳥取大学地域部) Yamashita, Hiroki (Faculty of Regional Sciences, Tottori University)	
研究課題 Research Subject	オーストラリアにおける乾燥地都市開発の特性とその持続性に関する研究 Characters and sustainability of urban developments in the arid land of Australia	
共同研究要旨 Summary of Joint Research	This year, to investigate the Alice Springs, which is a typical desert city of Australia. I worked on the study from the point of view of the formation process of the city, the characteristics of the land use, the desert city-specific urban functions, such challenges and prospects as a desert city.	

一般研究 6 General Research 6	対応教員 Corresponding Staff	恒川 篤史 Tsunekawa, Atsushi
研究代表者 Principal Researchers	坂本 敦 (広島大学大学院理学研究科) Sakamoto, Atsushi (Graduate School of Science, Hiroshima University)	
研究課題 Research Subject	アラントインによるストレス応答活性化の分子機構とその植物分子育種への応用 Molecular mechanism of stress response activation by allantoin and its application to plant molecular breeding	
共同研究要旨 Summary of Joint Research	Purine catabolism, an integral housekeeping activity for remobilizing and recycling nitrogen in plants, has recently been implicated in protection against stress. However, the mechanism behind this remains to be elucidated. We previously reported that allantoin, a major purine intermediary metabolite, might play a role in stress responses and adaptation, possibly by affecting phytohormone homeostasis and signaling, since allantoin accumulation stimulates abscisic acid (ABA) production, thereby activating stress responses and enhancing abiotic stress tolerance of Arabidopsis seedling. Here, we investigated the possible effect of allantoin accumulation on jasmonate (JA) signaling and responses, because the interplay between ABA and JA underlies a fundamental regulatory mechanism in plant defense against abiotic and biotic stresses. The results present here showed that allantoin can activate the MYC2-regulated JA signaling pathway in Arabidopsis via a mechanism involving ABA, thus providing a possible link between purine catabolism and the signaling pathways of these two interacting phytohormones that play critical roles in plant adaptation to stress.	

一般研究 7 General Research 7	対応教員 Corresponding Staff	辻本 壽 Tsujimoto, Hisashi
研究代表者 Principal Researchers	松岡 由浩 (福井県立大学生物資源学部) Matsuoka, Yoshihiro (Department of Bioscience, Fukui Prefectural University)	
研究課題 Research Subject	耐乾性パンコムギ育種に利活用できる遺伝資源の拡大: トランスコーカサスおよび中央アジアで新たに採集されたタルホコムギを用いた合成パンコムギ系統の作出 Broadening the genetic resource for drought-tolerance bread wheat breeding: production of synthetic bread wheat lines using newly collected Transcaucasian and Central Asian Aegilops tauschii accessions	
共同研究要旨 Summary of Joint Research	A diverse array of Aegilops tauschii Coss. accessions, including 98 accessions collected in Armenia (16 accessions), Georgia (35 accessions), Azerbaijan (24 accessions), Kazakhstan (14 accessions), and Tajikistan (9 accessions), were collected by the expedition team that Prof. Hisashi Tsujimoto, Arid Land Research Center, Tottori University led in the years of 2008-2012. These accessions may provide novel and valuable genetic resources for bread wheat breeding, because Ae. tauschii is the D-genome progenitor of allohexaploid common wheat (<i>Triticum aestivum</i> L.). To produce synthetic wheat lines using these materials, 11 accessions collected in Transcaucasus and eight accessions collected in central Asia were crossed as the male parent with a cultivar of <i>Triticum turgidum</i> L. used as the female parent. We then grew 10 triploid F1 hybrid synthetics (all derived from the Transcaucasus accessions) in a greenhouse for evaluation. All F1 synthetics showed hybrid abnormalities including hybrid	

	dwarfness and necrotic symptoms. As a result, seven F1 synthetics failed to produce F2 seeds, because, due to severe hybrid abnormalities, they died before they reach the reproductive stage. Three grew into maturity and set seeds of F2 that could be used for further evaluation. These results are consistent with that the Transcaucasus Ae. tauschii genepool contains the alleles that cause abnormality in the hybrids with <i>T. turgidum</i> .
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一般研究 8 General Research 8	対応教員 Corresponding Staff	辻本 壽 Tsujimoto, Hisashi
研究代表者 Principal Researchers	辻村 真衣 (京都産業大学植物ゲノム科学研究センター) Tsujimura, Mai (Plant Organelle Genomics Research Center, Kyoto Sangyo University)	
研究課題 Research Subject	葉緑体形質転換に適した緑色カルスを形成するコムギ実験系統の開発 Production of the green-callus forming wheat that can be used for chloroplast transformation	
研究分担者 Co-researchers	寺地 徹 (京都産業大学総合生命科学部) 山岸 博 (京都産業大学総合生命科学部) Terachi, Toru (Department of Bioresource and Environmental Sciences Faculty of Life Sciences, Kyoto Sangyo University) Yamagishi, Hiroshi (Department of Bioresource and Environmental Sciences Faculty of Life Sciences, Kyoto Sangyo University)	
共同研究要旨 Summary of Joint Research	<p>Chloroplast transformation is one of the techniques by which genetically modified plants are produced. Because of several advantages of transplastomics over conventional nuclear transformants, this technology has been applied successfully to many crops. However, in spite of tremendous efforts by many researchers, no transplastomic wheat has been produced yet.</p> <p>One of the problems in wheat is that pale yellow callus with only immature chloroplasts have to be used as the explant for particle bombardment. Hence, we became interested in the transcription factor GLK (Golden like 2) which prompts maturations of chloroplast. In rice, a GLK overexpressor is known to produce green callus even if the callus are derives from immature embryos. Therefore, we tried to introduce the gene GLK into nuclear genome of wheat using a particle bombardment system. To obtain embryos with high regeneration ability, material plants were grown in a chamber in ALRC, Tottori University, where growth conditions can be controlled strictly. Immature embryos were isolated from the seeds harvested 14 days after anthesis, and incubated at 25°C on the medium containing 2,4-D (2mg/L).</p> <p>Plasmid DNA possessing <i>glk</i> and <i>hpt</i> (a selectable marker gene) was delivered using PDS1000-He (BioRad) to the 59 plates each of which contained about 50 calluses. Bombarded callus are cultured in the medium containing selection reagent (Hygromycin, 30mg/L). After being cultured about 30 days, 206 plants were regenerated. DNA was prepared from each regenerated plant and presence of the transgenes was assayed by PCR. The PCR revealed two plants have both <i>glk</i> and <i>hpt</i> and three have only <i>hpt</i>.</p> <p>These transformants were obtainable under the same experimental conditions; 1,350psi helium pressure, and the period from the beginning of embryo culture to particle bombardment is 10-15 days. We are planning to examine these transformants in detail.</p>	

一般研究 9 General Research 9	対応教員 Corresponding Staff	安 萍 An, Ping
研究代表者 Principal Researchers	阿部 淳 (東海大学農学部応用植物科学科) Abe, Jun (Department of Plant Science, School of Agriculture, Tokai University)	
研究課題 Research Subject	ヤトロファ (<i>Jatropha curcas</i>) 実生苗の養水分欠乏に対する反応 Response to water and nutrient deficiency in the seedlings of <i>Jatropha curcas</i>	
共同研究要旨 Summary of Joint Research	<p><i>Jatropha curcas</i> is a promising plant that provides biodiesel fuel with greening degraded lands. In 2014, our joint research conducted an experiment with using small pots and reported the plastic morphology of <i>J. curcas</i> that root growth prevails over shoot growth under water/nutrient deficient conditions. In 2015, we used deeper pots (30 cm deep) to simulate more actual condition of soil. Seedlings of <i>J. curcas</i> were grown for 28 days in either well-watered (WW), watered only from bottom (DW), and dried (DD) conditions. Soil pF was 1.7-2.55 in WW, and up to 2.7 in DD, respectively. In DW and DD, seedlings with only adventitious roots (taproot was removed at sowing) were also cultured. <i>J. curcas</i> more dominantly developed root system than shoot in DW and DD. Lateral roots of <i>J. curcas</i> were developed vigorously in those treatments, whereas soybean roots did not respond to the same treatments so clearly. <i>J. curcas</i> seedlings whose taproot was removed showed compensatory development</p>	

	of lateral roots in adventitious roots, and as the result the shoot growth was not declined by the removal of the taproot in DW. In DD, however, removal of taproot clearly suppressed both the development of adventitious roots and shoot growth, indicating the important role of the taproot under seriously drought conditions.
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一般研究 10 General Research 10	対応教員 Corresponding Staff	安 萍 An, Ping
研究代表者 Principal Re-searchers	本間 知夫 (前橋工科大学工学部生物工学科) Honma, Tomoo (Department of Biotechnology, Maebashi Institute of Technology)	
研究課題 Research Sub-ject	電気計測手法による作物の耐塩性の非破壊的評価 Non-destructive evaluation of salt-tolerance of crops by using electric measuring method	
研究分担者 Co-researchers	地下 まゆみ (大阪大谷大学教育学部教育学科) Jige, Mayumi (Faculty of Education, Osaka Ohtani University)	
共同研究要旨 Summary of Joint Research	Against some kinds of crop seedlings whose salt tolerance was different (cabbage>Chinese cabbage>strawberry), effects of salt-treatment (a few supplies of 50mM and 500mM NaCl solution) on capacitance (Cs) & impedance (Z) measured by LCR meter were studied. These electrical parameters were changed (increase in Cs & decrease in Z) in all crops after salt-treatments. In order to clarify changes of these parameters originated by crops, effects of soil conditions should be subtracted or divided.	

一般研究 11 General Research 11	対応教員 Corresponding Staff	安 萍 An, Ping
研究代表者 Principal Re-searchers	杉本 幸裕 (神戸大学大学院農学研究科) Sugimoto, Yukihiro (Graduate School of Agricultural Science, Kobe University)	
研究課題 Research Sub-ject	根寄生雑草の宿主養水分収奪戦略に関する生理生化学的研究 Physiological and biochemical analyses of interactions between host and root parasitic plants	
研究分担者 Co-researchers	藤岡 聖 (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) Fujioka Hijiri (Graduate School of Agricultural Science, Kobe University) Yoshimoto, Chizu (Graduate School of Agricultural Science, Kobe University)	
共同研究要旨 Summary of Joint Research	<i>Striga hermonthica</i> , a debilitating root hemiparasitic weed of poaceous plants, is a threat to food security in sub-Saharan Africa. The parasite withdraws assimilates and nutrients from its host through the transpiration stream skewed to the parasite due to unusual stomatal behavior. In contrast to most plants in which stomatal closure is regulated by abscisic acid (ABA), our previous studies revealed that stomata of <i>Striga</i> hardly responded to ABA. In the academic year 2015, translocation of ABA from <i>Striga</i> to the host was studied using biological and chemical assays. For the biological assay ABA deficient maize mutant, vp14, heterozygous for ABA synthesis, seeds were provided by the Maize Genetics Cooperation Stock Center. The seeds were planted and the resulting plants were self-pollinated. Immature ears were harvested and stored under moist conditions to induce viviparous sprouting. The seedlings, transferred to rhizotrons had their ABA contents and stomatal opening measured. Plantlets with low ABA contents and widely opened stomata, under both wet and dry conditions, were infected with <i>Striga</i> . Stomata of the maize mutants were induced to close by <i>Striga</i> infection. However, the involvement of ABA, of <i>Striga</i> origin, in the host stomatal closure was not confirmed due to inconsistency in ABA contents. In the chemical approach, d6-ABA applied to <i>Striga</i> leaves was monitored. The labeled compound was detected in the host in some experiments, but not in others. A more elaborate experimental design is necessary to ascertain translocation of ABA from <i>Striga</i> to host plants.	

一般研究 12 General Research 12	対応教員 Corresponding Staff	安 萍 An, Ping
研究代表者 Principal Re-searchers	清水 英幸 (国立環境研究所地域環境研究センター) Shimizu, Hideyuki (Center for Regional Environmental Research, National Institute for Environmental Studies)	
研究課題 Research Sub-ject	大気汚染と水欠乏が半乾燥草原植物に及ぼす影響 Effects of air pollution and/or water deficiency on plants grown in semi-arid grasslands	

共同研究要旨 Summary of Joint Research	<p>Semi-arid grasslands in Northeast Asia might suffer the damage of air pollution, especially ozone, as well as overgrazing, global warming, etc. However, there is almost no experimental data available for assessing the impacts of ozone on native plant species.</p> <p><i>Agriophyllum squarrosum</i>, <i>Astragalus adsurgens</i>, <i>Hedysarum fruticosum</i>, <i>Medicago sativa</i>, <i>Artemisia ordosica</i>, <i>Artemisia sphaerocephala</i> and <i>Caragana korshinskii</i> growing around Mu Us sandy land were selected as experimental materials. Seedlings grown in glasshouse were exposed to 50 ppb ozone in average for 4 weeks using environment-controlled growth cabinets. Visible injury, leaf area and dry biomass in each organ were measured, and the growth analysis was performed.</p> <p>The relative growth rate (RGR) of almost all species was reduced (5-13%) by ozone except for <i>A. squarrosum</i> in which RGR increased in ca. 10%. In <i>A. adsurgens</i> on which visible foliar symptom of ozone-specific red-brown fleck was expressed, RGR was significantly reduced by 13%. Leaf senescence was also accelerated by ozone in <i>H. Fruticosum</i> and <i>M. sativa</i>. The specific leaf area (SLA) was increased by ozone in <i>A. Adsurgens</i>, <i>M. sativa</i> and <i>A. sphaerocephala</i>, indicating a thinner leaf. The root/shoot ratio was increased in <i>M. sativa</i> and <i>A. ordosica</i>, while decreased in <i>C. korshinskii</i>, indicating the modification of photosynthate allocation. These eco-physiological changes caused by ozone should be important and necessary to examine from the viewpoint of water deficiency in semi-arid grasslands.</p> <p>Seedlings of <i>M. sativa</i>, <i>A. ordosica</i> and <i>C. korshinskii</i> (moderate sensitivity to ozone) were treated to different water deficient regime with similar condition of the ozone experiment. Plants treated with two-thirds of the present level of precipitation of the local grassland were compared with those of control (90mm during 4 weeks). The RGR of water-deficient plant was decreased by 1%, 11% and 18% in <i>M. sativa</i>, <i>A. ordosica</i> and <i>C. korshinskii</i>, respectively. Eco-physiological changes including SLA, root/shoot ratio, etc. were also induced by water stress.</p> <p>In semi-arid grasslands close to Beijing, both water deficiency and ozone pollution impacts should be precisely analyzed together. Results of the present research would be valuable basic information on the desertification rehabilitation in semi-arid grasslands.</p>
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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	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	塩分ストレスが2種の塩生植物 <i>Suaeda salsa</i> (L.) Pall. と <i>Suaeda glauca</i> (Bge.)の生育と収量に与える影響 Effects of salt stress on growth and yield of two halophytes: <i>Suaeda salsa</i> (L.) Pall. and <i>Suaeda glauca</i> (Bge.)	
研究分担者 Co-researchers	近藤 謙介 (鳥取大学農学部) Kondo, Kensuke (Faculty of Agriculture, Tottori University)	
共同研究要旨 Summary of Joint Research	<p>1) Halophyte <i>Suaeda salsa</i> was grown in various supplemental CaCl₂ (0, 5, and 15 mM) concentrations under salt stress (250 and 500 mM NaCl). The dry weight was improved with the 15 mM CaCl₂ treatment compared with the 500 mM NaCl alone, and the Na content in the root decreased with the addition of calcium. This result showed that CaCl₂ ameliorated the growth of <i>S. salsa</i> at 500 mM NaCl, and that the cultivation of <i>S. salsa</i> under high salinity such as 500 mM NaCl can contribute to the effective utilization of saline soils.</p> <p>2) The growth of <i>S. salsa</i> increased at 25/15° C compared with 15/5° C. Most of the plants at 35/25° C withered and died. These results indicated that temperatures in the 20-25° C range were suitable conditions for growth for <i>S. salsa</i>. Furthermore, it tended to increased by the addition of 250 mM NaCl compared with control (0 mM NaCl). The growth of <i>S. salsa</i> tended to be promoted in this temperature zone and moderate NaCl concentration.</p> <p>3) <i>S. salsa</i> was exposed to different day-lengths (12 h/12 h, 13 h/11 h, and 14 h/10 h) under salt stress (100 and 200 mM NaCl). Flower buds appeared in the 12 h/12 h and 13 h/11 h day-lengths but not in the 14 h/10 h day-length. The flowering date tended to be delayed as the light period became longer. No extreme delay of flowering due to NaCl concentration was observed. These suggest that <i>S. salsa</i> can grow well without a delay in flowering under saline soils.</p>	

一般研究 14 General Research 14	対応教員 Corresponding Staff	岡本 昌憲 Okamoto, Masanori
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研究代表者 Principal Researchers	花田 耕介 (九州工業大学若手フロンティア研究アカデミー) Hanada, Kousuke (Frontier Research Academy for Young Researchers, Kyushu Institute of Technology)
研究課題 Research Subject	次世代シーケンスを用いたオオハマニンニクのトランスクリプトーム解析 Transcriptome analysis of <i>Leymus racemosus</i> by next generation sequencing
共同研究要旨 Summary of Joint Research	<i>Leymus racemosus</i> tends to have not only high biomass but also high stress tolerance such as drought, salinity and heat. Such the traits are lost in most of crops. Since <i>Leymus racemosus</i> can be breeding with wheat, wheat lines integrated with <i>Leymus racemosus</i> chromosome H, I and N were generated by Prof. Tsujimoto (The National University Corporation Arid Land Research Center, Tottori University). Wheat lines integrated with <i>Leymus racemosus</i> chromosome H, I and N have high tolerance of drought and salinity. Therefore, <i>Leymus racemosus</i> chromosome H, I and N are involved in genes associated with high tolerance of drought and salinity in wheat. To identify genes associated with high tolerance of drought and salinity in <i>Leymus racemosus</i> chromosome H, I and N, we try to generate DNA makers in each of <i>Leymus racemosus</i> chromosome H, I and N by next generation sequencing analysis.

一般研究 15 General Research 15	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	中国黄土高原のリョウトウナラ林における斜面に沿った土壌微生物群集の変化 Topographic variation in soil microbial communities in natural oak forest soils on Loess Plateau, China	
研究分担者 Co-researchers	今田 省吾 (京都大学フィールド科学教育研究センター) 岩岡 史恵 (京都大学農学研究科) Imada, Shogo (Field Science Research and Education Center, Kyoto University) Iwaoka, Chikae (Graduate School of Agriculture, Kyoto University)	
共同研究要旨 Summary of Joint Research	Soil microbes act important roles of soil nitrogen dynamics which is determine soil nitrogen availability for plants growth. The study aims to investigate the relationship between soil chemistry and microbial community structure along the topography mediated resource gradient in the semi-arid forest near arid boundary on the Loess Plateau, China. The study was conducted in natural indigenous oak (<i>Quercus liaotungensis</i>) forests on Mt. Gonglushan near Yan-an, Shanxi, China. Totally 9 small study plots were set on three slope position (upper, middle, and lower slope positions) along three different watersheds. Soil samples were collected from nine plots in 2014 and 2015. Soil chemical properties were measured and environmental DNA was extracted from soil samples. Soil and bacterial and archaeal community structures were determined by 16S rRNA gene sequence using next-generation sequencer, IonPGM, at Arid Land Research Center, Tottori University. In spite soil chemical properties such as EC, soil carbon and soil nitrogen widely changed among the slope positions, soil bacterial and archaeal community structure was not so different among slope positions. Rather differences in watershed and sampling timing were more important factors controlling soil bacterial community structure in this study site. It needs more detail study for geographical changes and seasonal changes for investigate the relationship between soil chemistry and microbial community structure along the topography mediated resource gradient.	

一般研究 16 General Research 16	対応教員 Corresponding Staff	山中 典和 Yamanaka, Norikazu
研究代表者 Principal Researchers	篠田 雅人 (名古屋大学環境学研究科) Shinoda, Masato (Graduate School of Environmental Studies, Nagoya University)	
研究課題 Research Subject	黄砂発生源対策のための風食・生態系統合モデルの開発 Developing an integrated wind erosion-ecosystem model for mitigation measure	
研究分担者 Co-researchers	甲斐 憲次 (名古屋大学環境学研究科) ナンディンチェエグ バンズラグチ (名古屋大学環境学研究科) シャオ ヤーピン (ケルン大学地球物理・気象学研究所) Kai, Kenji (Graduate School of Environmental Studies, Nagoya University) Nandinstesteg Banzragch (Graduate School of Environmental Studies, Nagoya University) Shao Yaping (Institute of Geophysics)	

	and Meteorology, University of Cologne)
共同研究要旨 Summary of Joint Research	Wind erosion depends on the relationship between erosivity (controlled primarily by wind strength) and erodibility (linked to land surface elements such as soil moisture, vegetation, and land use (e.g., grazing)) factors. Evidence has been accumulated on the erodibility of widespread bare lands in deserts, including surface roughness, surface crust, soil moisture, and others. However, in relatively wet areas of drylands (such as grasslands), vegetation and soil moisture that varies substantially in response to seasonally and interannually variable (but limited) precipitation have not fully been investigated as erodibility. Given this, we focused on temperate grasslands, specifically in Mongolia, that have such land surface characteristics. This study used process-based ecosystem model DAYCENT and unique saltation flux measurements to (1) identify primary land surface factors that control dust emission with soil moisture and vegetation components (live grasses, standing dead grasses, and litter) in a Mongolian grassland and (2) test the dead-leaf hypothesis proposed by previous observational studies that correlates plant biomass in summer and dust events the following spring. This approach helped develop an integrated wind erosion-ecosystem model as a final goal.

一般研究 17 General Research 17	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	中国の移動砂丘地での植栽に適したヤナギ科植物等の埋砂ストレスに対する応答と適応機構に関する研究 Studies on mechanisms of burial stress tolerance and adaptability of Salicaceae species suitable for the fixation of sand movement in China	
共同研究要旨 Summary of Joint Research	Effects of sand burial or erosion caused by wind on the growth and physiology of <i>Populus simonii</i> trees, planted in 2008, were investigated in Kubuqi desert, Inner Mongolia, China. Sand burial greatly influenced development of stem clusters by means of layering of buried branches and tree growth. Buried trees with sand showed higher $\delta^{13}C$ and accumulation of compatible solutes such as soluble sugar and alanine betaine in leaves. These results suggest that drought stress in buried individuals was greater than that in root eroded individuals. To evaluate the adaptability of <i>Populus simonii</i> trees to environmental changes in rhizosphere associated with sand movement, effects of sand erosion caused by wind on growth and root sucker formation in <i>P. simonii</i> trees, planted in 2012, were also investigated in Kubuqi desert. In the growth of axillary bud or root sucker formation increased levels of cytokinins caused by reduction of auxin level may be important in various plants. Root erosion simulated development of many ramets derived from root suckers formed on exposed portions of horizontal roots. These results suggest that not only changes in plant-hormonal balance such as increased cytokinin level but also photo irradiation on exposed roots may be essential in root sucker development in this species.	

一般研究 18 General Research 18	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	ヒルギダマシの高塩濃度耐性機構および生理機能解析のためのゲノム解析基盤の確立 The development of genomic basis for studies on the mechanism of salt tolerance and physiology in <i>Avicennia marina</i>	
共同研究要旨 Summary of Joint Research	<i>Avicennia marina</i> , is one of major mangrove species classified in the family Acanthaceae. It lives in the intertidal zones of estuarine areas and is regarded as one of the most salt tolerant mangrove species. Total RNA from five tissues including leaves, shoots, erect roots, horizontal roots, flower was extracted, a cDNA library was constructed from various tissues and was sequenced using Ion torrent sequencer. After quality assessment and data filtering, the cleaned raw reads were assembled into a total of 45,319 unigenes with an average length of 376 bp. Of the unigenes, 13,915 unigenes showed no homology to TAIR database. These ESTs are regarded specific to <i>Avicennia marina</i> genome. We also have picked up 3057 ESTs related to salt response based on Gene Ontology analysis. We have focused on the relationship between salt tolerance and compatible solutes accumulation, eight ESTs encoding	

	Betaine aldehyde dehydrogenase (BADH) were found and classified into three BADH genes (AmBADH1, 2, 3) based on the comparison of each amino acid sequence. The expression of AmBADH1 was relatively low among all tissues tested, while that of AmBADH2 was observed at all tissues showing higher level with flower, shoot and horizontal roots. AmBADH3 transcript showed lower level at leaves and horizontal roots. These data suggest that three BADH have a different regulation mechanism among tissues.
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一般研究 19 General Research 19	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	中国乾燥地植生回復事業における貧困問題、水資源配分問題による制約的影響力の研究—毛烏素砂漠治沙事業、京津風沙源対策事業を中心に A study on the restrictive influence of poverty and water resources distribution of the arid lands restoration programs in China-- Focusing on the MuUs Sandy restoration program and Beijing-Tianjin sandstorm source control project	
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) 何彦旻 (京都大学経済研究所) Kubota, Jumpei (Research Institute for Humanity and Nature) Kitagawa, Hideki (Faculty of policy Science, Ryukoku University) Yanmin He (Institute of Economic Research, Kyoto University)	
共同研究要旨 Summary of Joint Research	Our research discussed the conditions and mechanism of the Beijing-Tianjin Sandstorm Source Control Project, a national project located in the north of Beijing, aiming at regional endogenous development by the afforestation and local industry using thinned and regeneration wood in the recent 30 years. There are some background factors. Firstly, the project has been covered by the national finance and the direct subsidies to the forest farmers. Secondly, the area of the project is also designated for the water resources protection area (national project) which enabled to get an ecological compensation from the downstream region. Consequently, the afforestation and management costs for the local forest farmers were partly reduced, losses have been compensated by the fiscal mechanisms.	

一般研究 20 General Research 20	対応教員 Corresponding Staff	山中 典和 Yamanaka, Norikazu
研究代表者 Principal Researchers	松永 光平 (立命館大学文学部) Matsunaga, Kohei (College of Letters, Ritsumeikan University)	
研究課題 Research Subject	中国の乾燥域における生業転換と環境変化 Livelihood Transitions and Environmental Changes of Arid Land in China	
研究分担者 Co-researchers	佐藤 廉也 (九州大学比較社会文化研究院) 村松 弘一 (学習院大学学長付国際研究交流オフィス) Renya Sato (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>This study aims to evaluate risks of desertification due to livelihood transition in the Chinese drylands. In the Chinese drylands, since 1999, “Grain-for-Green Projects” which converts farmland to forest area has been implemented. Livelihood transition from agriculture to other livelihood is expected to loosen the impact of agriculture to local ecosystems. However, to keep livelihood transition from agriculture to another livelihood such as industry whose impacts are relatively large to local ecosystems, we have to efficiently use local water and land resources without any environmental conflicts such as desertification.</p> <p>In this study, Chinese drylands were defined as areas where drought index used in China is higher than 1.5. Six main provinces and autonomous regions were chosen as study areas. Provincial environmental changes were studied based on a Chinese national statistical yearbook. Livelihood transitions were examined using a provincial statistical yearbook on the China Data Online. Each province or autonomous region showed livelihood transitions from first industry to second industry from 1999 to 2009. By contrast, increase in industrial water in almost all provinces or autonomous regions was not observed. Therefore, currently, it is likely that livelihood transitions accelerated by “Grain-for-Green Projects” have no clear relationship to changes in the way of water use.</p>	

一般研究 21 General Research 21		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	新しい安定同位体分析を用いた乾燥地植物の水・窒素吸収源の把握 Water and nitrogen source of desert plants estimated by new isotope analysis		
研究分担者 Co-researchers	木庭 啓介 (東京農工大学農学研究院) 木庭 亜弥美 (東京農工大学農学研究院) 大石 有美 (三重大学生物資源学部) 磯部 知世 (三重大学生物資源学部) Koba, Keisuke (Institute of Agriculture, Tokyo University of Agriculture and Technology) Koba, Ayami (Faculty of Agriculture, Tokyo University of Agriculture and Technology) Oishi, Yumi (Faculty of Bioresources, Mie University) Isoe, Tomoyo (Faculty of Bioresources, Mie University)		
共同研究要旨 Summary of Joint Research	<p>The nitrogen (N) use by desert plants should be understood to improve the method for restoring the arid ecosystems where the bio-available water and nutrient are highly limited. Therefore, the supply of inorganic N such as nitrate and ammonium to plants was estimated by using Plant Root Simulator probes with ion exchange resin membranes (PRS® Probe, Western Ag, Canada). The N source of the plants was also estimated by comparing the nitrogen isotope ratio of nitrate and ammonium with that of plant organic matter. We tested this technique in a temperate Japanese cypress forest in Shiga Prefecture, Japan. The supply rate of nitrate to plants was significantly higher than that of ammonium both in winter and summer. The nitrogen isotope ratio of nitrate was lower than those of ammonium and organic nitrogen. These results suggest that nitrate derived from nitrification is a major N source of plants in the site. The nitrogen isotope ratio of leaf organic matter was similar to that of nitrate in summer, suggesting that Japanese cypress trees in the site mainly depended on nitrate. Our results indicate that the technique employed in this study is useful to estimate the N source of plants in the humid environments.</p>		

一般研究 22 General Research 22		対応教員 Corresponding Staff	山中 典和 Yamanaka, Norikazu
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	乾燥地に自生する生薬カンゾウの栽培体系の構築 Construction of cropping systems of licorice (<i>Glycyrrhiza uralensis</i> Fisher) growing to arid land		
研究分担者 Co-researchers	谷口 武士 (鳥取大学乾燥地研究センター) Taniguchi, Takeshi (ALRC, Tottori University)		
共同研究要旨 Summary of Joint Research	<p>We conducted different experiments about glycyrrhizin (GL) accumulation in taproots under both hydroponic culture/field and about number of stolon of licorice. Cutting stem was increased both concentration and content of GL. The number of stolon became greatest near N-P2O5-K2O=17-9.5-9 kg/10a.</p>		

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	小林 幹佳 (筑波大学生命環境系) Kobayashi, Motoyoshi (Faculty of Life and Environmental Sciences, Tsukuba University)		
研究課題 Research Subject	高分子電解質をベースとした土壌侵食抑制剤の高度利用技術の開発 Development of advanced application technology of polyelectrolytes-based soil amendments against erosion		
研究分担者 Co-researchers	山田 健太 (筑波大学大学院生命環境科学研究科) Yamada, Kenta (Graduate School of Life and Environmental Sciences, University of Tsukuba)		

共同研究要旨 Summary of Joint Research	<p>In arid land, the control of soil erosion is of great importance for sustainable agriculture and efficient use of water resource.</p> <p>In this research, we examined two kinds of solutions of polyion complex (PIC) of cationic and anionic polymers as inhibitors of soil erosion: (1) synthetic PIC, 1 wt.% polydiallyldimethyl ammonium chloride, 0.435 wt.% polyacrylic acid, 0.5 mol L⁻¹ KNO₃ and 0.06 mol L⁻¹ KOH and (2) natural PIC, 0.5 wt.% carboxymethyl cellulose, 1.5 wt.% cationic cellulose, 0.2 M KNO₃.</p> <p>We evaluated the inhibitory effect of the PIC on soil erosion of Tottori Masa soil under simulated rainfall. The effect of commercially available liquid fertilizer was also examined instead of KNO₃. In addition, to investigate the transport of ionic substances in soil under the influence of crust formation, the temporal change of EC was measured at upper and lower parts of the bottom of a soil box.</p> <p>We obtained the following results:</p> <p>(1) The effect of synthetic PIC: The result of our experiment confirmed that the runoff and soil loss were decreased by the addition of larger amount of the synthetic PIC solution. The liquid fertilizer was available instead of KNO₃.</p> <p>(2) The effect of natural PIC: Natural PIC solution significantly reduced the runoff and soil loss compared with synthetic PIC solution. That is, runoff and soil loss were almost 0 when natural PIC solutions were applied 1 and 3 L m⁻².</p> <p>(3) Transport of ionic substances: At this moment, we could not observe clear effects of PIC and raindrop impact on the temporal change of EC in the soil. This point should be examined more carefully in future works.</p>
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一般研究 24 General Research24	対応教員 Corresponding Staff	藤巻 晴行 Fujimaki, Haruyuki
研究代表者 Principal Re- searchers	齋藤 広隆 (東京農工大学大学院農学研究院) Saito, Hirota (Institute of Agriculture, Tokyo University of Agriculture and Technology)	
研究課題 Research Sub- ject	乾燥地における節水灌漑下での土中局所温度制御効果に関する研究 Effect of controlling local soil temperature under water saving irrigation in arid land.	
研究分担者 Co-researchers	三宅 光葉 (東京農工大学大学院農学府) Miyake, Mitsuha (Graduate School of Agriculture, Tokyo University of Agriculture and Technology)	
共同研究要旨 Summary of Joint Research	<p>A typical capillary barrier system consists of two layers with contrasting hydraulic properties, in which a finer layer overlays a coarser layer. Water from the finer layer cannot cross the interface until the matric potential head at the interface reaches a given value where the coarser layer becomes conductive. The coarser layer then acts as a temporal impermeable layer, known as a capillary barrier. CBs have been used to control infiltration of water in soils to increase root zone water retention capacity for cultivation of horticultural crops. This study examined the effect of temperature gradient induced by heating the ground locally under water-saving irrigation on water flow, solute transport, and plant growth with CB. In this study, cultivation experiments were conducted in a temperature controlled phytotron in Tokyo University of Agriculture and Technology. Komatsuna (<i>Brassica rapa</i> var), one of the common leafy vegetables, was cultivated during summer of 2015 in rectangular containers with CB. One container used as a reference (R-plot) was filled with Tottori dune sand only. To increase the temperature at a given depth, a tube-shape heat exchangers was installed at 10-cm depth (S-plot). In one container, referred to as D-plot, an additional heat exchanger was installed at 5-cm depth. Warm water was circulated during night (from 6 pm to 6 am the next day) to generate upward temperature gradient in the soil. Irrigation rates were gradually decreased from 3 mm per day to 1 mm per day in the end of the experiment. As a result, Komatsuna in the R-plot was completely killed. Komatsuna in the S-plot was slightly larger than that in the D-plot. In conclusion, liquid water and water vapor transported by the temperature gradient in the soil acted as a supplemental water source and it can be applied in arid or semi-arid regions.</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 Re- searchers	森井 俊広 (新潟大学農学部) Morii, Toshihiro (Faculty of Agriculture, Niigata University)	

研究課題 Research Subject	部分埋設型 CB (キャピラリー・バリア) を利用した節水かんがいシステムの開発 Study on water saving irrigation using partially-embedded CB (capillary barrier)
共同研究要旨 Summary of Joint Research	A simple soil layer system which constitutes of a finer soil layer underlain by a coarser soil layer shows an excellent characteristic of capillary barrier (CB). Downward percolation of water during infiltration or redistribution ceases where the infiltrated water migrating through the sand layer encounters the gravel layer, and the water accumulates just above an interface between the soil layers with less percolating into the gravel layer lower. As their roots can easily utilize the water retained within the upper soil layer, agricultural plants grow well even under supply of less irrigation water. In order to study feasibility or applicability of the CB system of soil in an arid or semi-arid area, a site investigation was conducted in the West Bank of the Jordan River, Palestine, during 20 to 25 March, 2015. The CB test plot was constructed in the olive orchard near Ramallah City and, since then, the soil moisture contents in the CB system of soil have been monitored in the field. In this paper, the soil moisture contents measured in the CB test plot are plotted during 79 days after 23 March, 2015, and compared with those measured in the orchard soil without the gravel layer.

一般研究 26 General Research 26	対応教員 Corresponding Staff	谷口 武士 Taniguchi, Takeshi
研究代表者 Principal Researchers	大和 政秀 (千葉大学教育学部) Yamato, Masahide (Faculty of Education, Chiba University)	
研究課題 Research Subject	降水量傾度に伴うモンゴル草原のアーバスキュラー菌根共生の変化 Change in arbuscular mycorrhizal symbiosis in Mongolian steppes along a precipitation gradient	
研究分担者 Co-researchers	山中 典和 (鳥取大学乾燥地研究センター) 日下部 亮太 (千葉大学教育学研究科) Yamanaka, Norikazu (ALRC, Tottori University) Kusakabe, Ryota (Graduate school of Education, Chiba University)	
共同研究要旨 Summary of Joint Research	<p>Vegetation degradation caused by grazing has been a serious problem in Mongolian steppe. We examined the community structures of arbuscular mycorrhizal (AM) fungi in two regions, Hustai with higher precipitation and Mandalgovi with lower, in order to see the effect of grazing and aridity on the AM symbioses.</p> <p>In each region, three areas with different grazing levels, Slight, Moderate and Bad, were determined and nine sampling plots were set for each grazing levels. Soil core samples were collected in each plot, and AM fungal DNA isolated from the obtained roots was examined through molecular techniques using the Ion PGM sequencing system.</p> <p>In both regions, biomass of Poaceae plants decreased with increase of the grazing levels. With decrease of the Poaceae biomass, Asteraceae plants increased in Hustai, while Chenopodiaceae plants increased in Mandalgovi. In Hustai, the community structure of AM fungi was significantly diversified among the different grazing levels, in which significant correlations were detected between the community structure and environmental variables such as plant biomass, number of plant species, soil pH, and soil P. The most abundant AM fungal OTU (operational taxonomy unit), identified as Rhizophagus fungi, were dominant in the area with Slight grazing, thus this fungal group may have an affinity to the Poaceae plants. These results suggest that the effect of grazing on AM fungal community would be significant in the examined Mongolian steppe.</p>	

一般研究 27 General Research 27	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	塩類ストレス下における菌根菌を介した樹木間養分転送機構の解明 Mechanisms of nutrient transfer among trees via mycorrhizal fungi under high salinity conditions	
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 (mesh size, 50 μ m). The soil for cultivation was collected from Miyake-Jima island (about 200 km south of Tokyo) where <i>Pinus thunbergii</i> and <i>Alnus sieboldiana</i> are dominated. A <i>Frankia</i> isolate from <i>A. sieboldiana</i> were used to form root nodules on	

	<p>alder seedlings planted in the containers. After eight month cultivation, all alder seedlings formed their root nodules, and grew well. The roots of pine seedlings without alder seem to grow better than those with alder, indicating that the soil nitrogen should be low without supply of nitrogen by alder. However, there was no EM species associated with pine and alder simultaneously.</p> <p>In the present study, the mesh size of nylon mesh bag available for cultivation of pine and alder was determined, and nodules could be formed after inoculation with Frankia culture. These results should be available for the study on function and management of mycorrhizal symbiosis.</p>
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一般研究 28 General Research 28	対応教員 Corresponding Staff	谷口 武士 Taniguchi, Takeshi
研究代表者 Principal Researchers	岩瀬 剛二 (帝京科学大学生命環境学部自然環境科学科) Iwase, Koji (Department of Natural and Environmental Science, Faculty of Life and Environmental Sciences, Teikyo University of Science)	
研究課題 Research Subject	油糧植物ジャトロファの成長促進と乾燥耐性に関する根系共生菌依存性の解析 Dependence analysis of oilseed plant, <i>Jatropha curcas</i> in growth promotion and drought resistance on root system symbiotic fungi	
研究分担者 Co-researchers	福井 希一 (大阪大学大学院工学研究科) 土本 卓 (大阪大学大学院工学研究科) 酒井 啓江 (大阪大学大学院工学研究科) 荻野 優奈 (帝京科学大学生命環境学部) 留森 寿士 (鳥取大学乾燥地研究センター) 辻本 壽 (鳥取大学乾燥地研究センター) 亀谷 優気 (帝京科学大学生命環境学部) 和田 直樹 (大阪大学大学院工学研究科) 伏見 力 (国際農林水産業研究センター熱帯・島嶼研究拠点) Fukui, Kiichi (Graduate School of Engineering, Osaka University) Tsuchimoto, Suguru (Graduate School of Engineering, Osaka University) Sakai, Hiroe (Graduate School of Engineering, Osaka University) Ogino, Yuuna (Faculty of Life and Environmental Sciences, Teikyo University of Science) Tomemori, Hisashi (Arid Land Research Center, Tottori University) Tsujimoto, Hisashi (Arid Land Research Center, Tottori University) Kameya, Yuuki (Faculty of Life and Environmental Sciences, Teikyo University of Science) Wada, Naoki (Graduate School of Engineering, Osaka University) Fukushima, Tsutomu (Tropical Agriculture Research Front, Japan International Research Center for Agricultural Sciences)	
共同研究要旨 Summary of Joint Research	<p>1. Isolation of Dark septate endophyte (DSE): Inoculation of 21 isolates of DSE, which were obtained in the fiscal year 2014, to the host plant, radish, was conducted to confirm the symbiotic ability of those strains. One strain was selected by this symbiotic ability and growth rate on the conventional medium.</p> <p>2. Establishment of rooted cuttings of <i>Jatropha</i> and inoculation of root system symbiotic fungi: As for the collected strains in the Laboratory of Arid Land Plant Resources, Arid Land Research Center, Tottori University, available number of cuttings was insufficient for the experiments. One hundred cuttings of Tanzanian <i>Jatropha</i> growing in Ishigaki Island were obtained and rooting induction was conducted to get 65 rooted cuttings. Among them, 40 cuttings were divided into 10 each of 4 groups, the uninoculated cuttings as a control, the cuttings inoculated with AM fungi, the cuttings inoculated with DSE fungi, and the cuttings of double inoculation with AM and DSE fungi. About 2 months later, high and very low colonization rate were obtained for AM and DSE, respectively. Growth promotion for tree height and base diameter were obtained in the experimental section of both AM inoculation and double inoculation.</p> <p>3. Transformants of <i>Jatropha</i> and inoculation of root system symbiotic fungi: Three kinds of transformants of <i>Jatropha</i> developed in Osaka University were obtained. They were 7 individuals of AtPPAT #14, 3 individuals of AtPPAT #16 and 2 individuals of AtNF-YB #5. The number of transformants was insufficient for the confirmation experiment of growth promotion, they were used for the confirmation of symbiotic ability to root system symbiotic fungi. As a result, the transformants were maintained to have symbiotic ability to AM fungi.</p>	

一般研究 29 General Research 29	対応教員 Corresponding Staff	伊藤 健彦 Ito, Takehiko
研究代表者 Principal Researchers	辻 大和 (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行動・繁殖特性と生息環境の関係 Relationships between behavioral/reproductive traits of primates in aridlands/cool region and their habitat environments
共同研究要旨 Summary of Joint Research	<p>I collected information on 1) locations of study sites, 2) activity budgets (time percentage), 3) moving distances, 4) home range size, 5) birth rate, 6) infant mortality, and 7) age at first birth of three primate groups inhabiting arid environments (baboons, patas monkeys, and savanna monkeys), and two groups inhabiting cool environments (macaques and colobines). I calculated NDVI values in areas within 5km in radius of each study site by using satellite image analysis and GIS analysis software of Arid Land Research Center. Besides I collected environmental information (mean temperature, annual rainfall, annual snowfall, altitude) of each study site. I analyzed relationships between environmental conditions and activity/ranging behavior/population parameters of characteristics of primates.</p> <p>Macaques increased resting time and decreased social behavior in habitat with high altitude. The macaques increased moving time and decreased feeding time in habitat with high NDVI, while they increased social behavior and decreased resting in habitat with higher temperature. Colobines increased moving and decreased resting in habitat with higher latitude. The colobines increased feeding and social behavior and decreased resting in habitat with higher altitude, while they increased resting and decreased other behavior in habitat with higher temperature. Finally, baboons increased moving in habitats with higher NDVI and temperature, while increased social behavior and decreased resting in habitat with higher rainfall. This study revealed relationship between environmental condition and activity are various among the family Cercopithecidae. The difference would be attributed to difference in behavioral traits for adapting given environmental condition.</p>

一般研究 30 General Research 30	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	<p>草原化に対する景観保全活動による鳥取砂丘の植生分布の変遷と砂移動回復状況のモニタリング Monitoring of sand move remediation and distribution of vegetation with landscape conservation activity for anti-glass-land in Tottori sand dune</p> <p>尾崎 陽三 (大阪工業大学工学部) 黒木 勝紀 (大阪工業大学工学部) 近藤 択哉 (大阪工業大学工学部) 川浪 雄一郎 (大阪工業大学工学部) 利根 穂志美 (大阪工業大学工学部) 科野 佑介 (大阪工業大学工学部) 仲岡 優 (大阪工業大学工学部) Ozaki, Yozo (Faculty of Engineering, Osaka Institute of Technology) Kuroki, Katsunori (Faculty of Engineering, Osaka Institute of Technology) Kondo, Takuya (Faculty of Engineering, Osaka Institute of Technology) Kawanami, Yuichiro (Faculty of Engineering, Osaka Institute of Technology) Tone, Hoshimi (Faculty of Engineering, Osaka Institute of Technology) Shinano, Yusuke (Faculty of Engineering, Osaka Institute of Technology) Nakaoka, Yu (Faculty of Engineering, Osaka Institute of Technology)</p>	
共同研究要旨 Summary of Joint Research	<p>Natural monument Tottori sand dune have varied in which land cover were sand dune-glass land-sand dune, by landscape conservation activity, in recent 50 years. In this study, we aimed three points that should clarify. 1) Grasping a spatial distribution and time series of sand movement and vegetation cover. 2) Evaluation of effect for sand move remediation by landscape conservation activity. 3) Evaluation of a recent landscape conservation activity effectiveness which include removal of a sand-protection-forest and weeding.</p> <p>We made 10-meter grid of digital elevation model based on air map survey which was performed in 1964, 1974, 1981, 1996, 2001, 2006 and 2011. Quantity of sand movement was evaluated as variation of height at each grid. Normalized Vegetation Index (NDVI) was calculated by using Landsat scene archives obtained from 1984 to 2014. Distributions of vegetation cover ratio were estimated by applying the regression formula to Landsat archive images from 1980 to 2000 era. We generated 30 meter grid points in GIS system, and quantity of sand movement and vegetation cover ratio of each grid were analyzed, and analyzed a transition of vegetation distribution and sand movement.</p> <p>Absolute mean of annual sand movement had been 0.27 meter from 1964 to 2001 in bare sand dune. The quantity of erosion and deposition was nearly balanced. We estimated, namely, that annual average of sand movement in the place where was not became glass-land was 27 cm (median was 20 cm). However, quantity of sand movement became smaller in the whole of Tottori sand dune from 1980 to 1990 era. It indicates that the sand movement got retarded in this period. In recent, sand movement</p>	

	have recovered already 25cm as same as quantity of ordinal sand dune area in a managing vegetated area after starting weeding as landscape conservation activity.
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一般研究 31 General Research 31	対応教員 Corresponding Staff	木村 玲二 Kimura, Reiji
研究代表者 Principal Researchers	間野 正美 (千葉大学大学院園芸学研究科) Mano, Masayoshi (Graduate School of Horticulture, Chiba University)	
研究課題 Research Subject	地表面熱収支における地中熱流量を簡易かつ高精度に連続測定する手法の確立 Establishment the simple, accuracy and continuous measurement method for soil heat flux in the surface energy balance equation	
共同研究要旨 Summary of Joint Research	Placing heat flux plates near the soil surface to measure soil heat fluxes induce exposure of the heat flux plates by loss of overlying soil, and hence it is sometimes difficult to acquire correct data. To overcome this difficulty, a method for estimate of the surface soil heat flux using the heat flux plates buried at some depth was investigated. The heat flux plate (purchased by this fund) was installed at 8 cm depth and a thermal conductivity sensor was buried at the field. The surface soil heat flux was calculated using a Green's function, which require the soil heat flux at 8 cm depth at the current time and the surface soil heat fluxes and thermal diffusivities prior to the current time. Calculated surface soil heat fluxes were compared to measured surface soil heat fluxes (i.e. reference values) by the heat flux plate (purchased by this fund) installed just below the soil surface. An installation situation of the heat flux plate was confirmed once in 2 or 3 days. Calculated surface soil heat fluxes using prior time series of calculated values (i.e., already calculated surface soil heat fluxes) were overestimated to compare with the reference values. On the other hand, when prior time series of observed values were used, differences between calculation and reference values became small. This suggests that the importance of early time-stage of calculation; because if calculated values are very close to the reference values at the beginning, it provides more correct calculation on the next time step. The error of calculation most likely results from the thermal diffusivity measurement. According to the manual of thermal conductivity sensor, its expected accuracy is +/- 20%. Therefore, further studies using the other methods/sensors to determine the thermal diffusivity are necessary to validate this method.	

一般研究 32 General Research 32	対応教員 Corresponding Staff	木村 玲二 Kimura, Reiji
研究代表者 Principal Researchers	王 秀峰 (北海道大学大学院農学研究院) Wang, Xiufeng (Graduate School of Agriculture, Hokkaido University)	
研究課題 Research Subject	人工衛星データを用いたデータ同化のダハラオアシスにおけるコムギ生育モデルへの適用 Application of data assimilation with staellite data to crop response model of wheat for Dakhla oasis, Egypt	
研究分担者 Co-researchers	岩崎 えり奈 (上智大学外国語学部) 加藤 博 (一橋大学大学院経済学研究科) 福田和正 (千葉大学大学院園芸学研究科) Iwasaki, Erina (Faculty of Foreign Studies, Sophia University) Kato, Hiroshi (Graduate School of Economy, Hitotsubashi University) Fukuda, Kazumasa (Graduate School of Horticulture, Chiba University)	
共同研究要旨 Summary of Joint Research	<p>Since 2009, we are conducting joint research on Rashda village in Dakhla oasis in Egypt with ALRC (Arid Land Research Center of Tottori University), and NARSS (National Authority for Remote Sensing & Space Sciences) to elucidate the management and utilization of water by farmers. Fukuda et al.(2016), measured soil moisture and irrigation amount of the field in Rashda and interviewed the farming system including crop rotation in September , 2015. They found that 1) the crop rotation system and irrigation interval and irrigation amount were determined by the government, 2) irrigation amount by the farmers is 20% more than the recommended amount by government in summer season and 3) as much as it in winter season.</p> <p>During their field observation, they also measured crop height, LAI, root depth, soil permeability, invasive capacity, ratio of soil crack and profile of soil moisture were measured hydraulic conductivity of the soil, invasive potential, crack area, such as soil moisture profile. Based on these results, they developed simulation model for soil moisture and crop growth divided field into six compartments with soil water movement. The result of simulation realized the soil moisture conditions and crop growth but they determined crop coefficients and soil permeability which is necessary to determine real evapo-transpiration of the crop and amount of water exchange by empirical or “trial and error” method as older models. To apply this model to wider area with satellite data, we need to determine these parameter with objective method.</p>	

一般研究 33 General Research 33	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	地表面温度分布を利用した砂丘地域の帯水層における水みちの推定 Evaluation of flow path in the sand dune aquifer by using soil surface temperature	
研究分担者 Co-researchers	河合 隆行 (新潟大学災害・復興科学研究所) 天野 弘基 (長崎大学大学院水産・環境科学総合研究科) Kawai, Takayuki (Research Institute for Natural Hazards and Disaster Recovery, Niigata University) Amano, Hiroki (Graduate School of Fisheries Science and Environmental Studies, Nagasaki University)	
共同研究要旨 Summary of Joint Research	<p>As a method to evaluate the groundwater flow and the geologic structure which becomes the obstacle to the flow, a new method using thermography images of the soil surface temperature is proposed. A flow tank filled with glass beads was used in the laboratory experiment. The obstacles blocks were arranged at random in the bottom of the flow tank. 6 patterns for obstacles distribution were designed, and hydraulic head difference between upper and lower boundary was performed in case of 5 mm and 8 mm for each pattern. The tap water was heated to 60 degrees centigrade was used as a tracer. During experiment, the surface temperature was taken by the thermography camera at specified time intervals. The experimental results showed that the distribution of the obstacles is having an influence on the temperature difference. However, the evaluation of the obstacle distribution was unclear by the proposed experiments. In order to improve the experimental method, continuous thermal tracer injection method was applied. By changing covered ratio, the ability of obstacles detection was evaluated. The results revealed that the proposed method has a potential to detect underground low permeable sediments.</p>	

一般研究 34 General Research 34	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生物科学科) Yoda, Kiyotsugu (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乾燥耐性におけるシードガムの役割の評価 Evaluation of the role of seed gum to the drought tolerance 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>Internal structures of seed coat of invasive <i>Prosopis juliflora</i> during seed imbibition were observed with Environmental Scanning Electron Microscope (ESEM). Cross-cut surface of seeds were immersed in water for a few minutes to one night, and observed the structure of seed coats before and after the immersion. Surface of seed coats after 10 min. sulfuric acid treatment were also observed. Water content capacity of seed gum extracted imbibed seeds was investigated by measuring weight change during desiccation treatment.</p> <p>Internal structure of seed coats in dry condition was composed of the following parts; outermost cuticle layer, one layer of palisade cells including light-line, two rows of osteoscleroid cells (hour-glass cells) with inserting sclerified mesophyll between them, innermost rod-shaped parenchyma, corresponding to previous reports on leguminous seeds. After immersed in water, the innermost parenchyma cells dissolved rapidly within several minutes, and became to 'mucilaginous' -like layer drastically. Outermost cuticle layers were removed by sulfuric acid treatment, and upper parts of regularly arranged palisade cells were recognized. Mucilaginous-like layers, or 'seed gum', showed clear water retention property with desiccation treatment, and as an example, a cake of seed gum had four-times of water retention in weight, and one-point eight times of duration in water retention time during desiccation treatment. These results suggest that the innermost rod-shaped parenchyma cells have a role of drought tolerant property of <i>Prosopis</i> seeds in arid regions.</p>	

一般研究 35 General Research 35	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, Kousuke (School of Agriculture, Meiji University)	
研究課題 Research Subject	異なる灌漑水量の決定法における砂丘畑の窒素循環 – アンモニアガスの揮散量および硝酸態窒素の溶脱量の定量化- Nitrogen Cycle in Sandy Fields under Different Irrigation Scheduling Strategies: Quantifying Ammonia Volatilization and Nitrate Loss from Sandy fields	
研究分担者 Co-researchers	徳本 家康 (佐賀大学農学部) 藤巻 晴行 (鳥取大学乾燥地研究センター) 柴田 雅史 (鳥取大学大学院農学研究科) 小宮 秀治郎 (明治大学大学院農学研究科) Tokumoto, Ieyasu (Faculty of Agriculture, Saga University) Fujimaki, Haruyuki (Arid Land Research Center, Tottori University) Shibata, Masashi (Graduate School of Agriculture, Tottori University) Komiya, Shujiro (Graduate School of Agriculture, Meiji University)	
共同研究要旨 Summary of Joint Research	<p>Tokumoto et al. (2014) show that impact of nitrous oxide emissions on nitrogen loss is small, but impact of nitrate leaching seems huge. The objective of this study was to evaluate ammonia emission from sandy fields with the photo-acoustic method when the two different irrigation methods were applied to the best management practice for potato product at the Arid Land Research Center. Our findings were:</p> <ol style="list-style-type: none"> 1. Ammonium concentration was considerably low even during crop growing season. This suggests that the gas flux was negative. 2. Although evaluation of accuracy of ammonia concentration is needed, the impact of ammonia emission on nitrogen loss was small. 3. For soil moisture monitoring system to understand nitrogen cycle, we examined the field-scale soil moisture observation system with the Cosmic-ray method (COSMOS). The advantage of COSMOS was to measure the average of soil moisture in the field scale (300-m radius), which is larger than the point measurement scale (a few-cm radius). In particular, backpack type-COSMOS probe was effective to observe soil moisture adequately. 	

一般研究 36 General Research 36	対応教員 Corresponding Staff	安田 裕 Yasuda, Hiroshi
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	地質 - 地下水 - 植生のクロスチェックによる半乾燥草原地帯における地下水集中地点の抽出方法 New extraction method of the groundwater concentration point with geology - groundwater - vegetation information in semi - arid grassland	
共同研究要旨 Summary of Joint Research	<p>Field observations were carried out in August 2015 in a two-point of Mongolia. Study area (Mogod city, Bulgan provinde) is the igneous rock zone to dominant of andesite and granite. A shallow groundwater slope was selected after the wide area field investigation. Four types of measurements were conducted on the 500m survey line of the slope. 1. Groundwater aeration sound survey: Measurements were performed at 10m intervals. The resulting sound data were substituted into an existing correlation equation to estimate the groundwater level. 2. 2D resistivity imaging survey: The dipole dipole method was applied to exploration and analyzes the geological structure. 3. Ground penetrating radar survey: It was estimated geologic structure using the reflected wave of 100MHz and groundwater level using the 500MHz. 4. Vegetation survey: It performed a vegetation check on the survey line of geophysical survey and conducted identification of the predominant species. From the 2D resistivity imaging survey and GPR survey, it was found that saturated water is concentrated near the boundary of the geological structure. From the groundwater aeration sound and GPR survey, the water table was confirmed to be a 3-5m. In particular, the groundwater aeration sound was large relatively in the vicinity of the geological boundary. In addition, the development of Stipa that was predominant species of the region was also good relatively at same point.</p>	

一般研究 37 General Research 37	対応教員 Corresponding Staff	黒崎 泰典 Kurosaki, Yasunori
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研究代表者 Principal Researchers	関山 剛 (気象庁気象研究所) Sekiyama, Tsuyoshi (Meteorological Research Institute, Japan Meteorological Agency)
研究課題 Research Subject	エアロゾル数値モデルと観測データの比較による黄砂発生プロセス理解の深化 Deepening the comprehension of the aeolian dust emission process by comparing aerosol numerical simulations with observational data
研究分担者 Co-researchers	眞木 貴史 (気象庁気象研究所) 大西 一成 (鳥取大学医学部) Maki, Takashi (Meteorological Research Institute, Japan Meteorological Agency) Onishi, Kazunari (Faculty of Medicine, Tottori University)
共同研究要旨 Summary of Joint Research	<p>We conducted a numerical simulation of Asian dust and sulfate aerosol distributions using the Japan Meteorological Agency (JMA) Model of Aerosol Species IN the Global Atmosphere (MASINGAR) mk2, which was installed into the server equipped at the Arid Land Research Center (ALRC) of Tottori University last fiscal year. Although we conducted a similar numerical simulation last year, the horizontal resolution was altered from the last year's 110 km into a two times higher 55 km and an 8-year simulation was performed from 2008 to 2015 with the 55 km resolution. This high-resolutionization made higher the accuracy of the Asian dust and sulfate aerosol simulation.</p> <p>However, the twofold horizontal resolution needs approximately tenfold computational resources because 1) the twofold horizontal resolution results in the fourfold number of grid points ($2 \times 2 = 4$), 2) the twofold horizontal resolution requires a half discretized time (= ΔT in the simulation) and therefore the computational burden becomes eightfold ($4 \times 2 = 8$), and 3) the high computational burden results in the degradation of data transfer efficiency. Actually, the MASINGAR mk2 simulation performed this year consumes the approximately maximum computational power of the ALRC server, which is impossible to be performed by conventional PCs. A half of year was needed to calculate the 8-year simulation.</p> <p>This dataset, an 8-year Asian dust and sulfate aerosol distributions, was provided to Prof. Kurosaki of the ALRC for the research on Asian dust emission processes, and to Prof. Onishi of the faculty of medicine of Tottori University for the research on cross-border pollution and health effects. We found that the cross-border pollution calculated by MASINGAR mk2 was highly correlated with the health survey result collected around Yonago City. These circumstances of cross-sectional research are an advantage of the Joint Research Program of the ALRC.</p>

一般研究 38 General Research 38	対応教員 Corresponding Staff	恒川 篤史 Tsunekawa, Atushi
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	液化炭素源の葉面散布が植物生育に与える影響 Effect of foliar spray by liquid carbon source on plant growth	
研究分担者 Co-researchers	遠藤 常嘉 (鳥取大学農学部) 金剛 穂波 (地方独立行政法人大阪府立環境農林水産総合研究所食の安全研究部土壌グループ) 内山 知二 (地方独立行政法人大阪府立環境農林水産総合研究所食の安全研究部土壌グループ) Endo, Tsuneyoshi (Faculty of Agriculture, Tottori University) Kongo, Honami (Research Institute of Environment, Agriculture and Fisheries, Osaka Prefecture) Uchiyama, Tomoji (Research Institute of Environment, Agriculture and Fisheries, Osaka Prefecture)	

一般研究 39 General Research 39	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	野生種トマトを活用した各種ストレス耐性の分子機構研究 Studies on molecular mechanisms of stress resistance in wild tomatoes	
共同研究要旨 Summary of Joint Research	Tomato plants were originated from South and Central American countries. Several wild species are still grown in those counties such as Peru, Chile and Mexico. 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 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 given by the Tomato Genetics Resource Center, UC-Davis. Those species were grown in facilities of Arid Land Research Center and Faculty of Agriculture. In addition, characterization of <i>Trichoderma</i> species and possible application of those isolates for biocontrol of diseases in the South American countries. Research facilities of Arid Land Research Center were useful for the research project. Disease resistance of the wild tomatoes was examined 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. The susceptibility of these wild species are induced by a mutation at the disease resistant gene of cultivated and wild tomato species. Several <i>Trichoderma</i> species showed potential for biocontrol agents against important diseases on tomato, banana and cacao cultivated in the South American countries.
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一般研究 40 General Research 40	対応教員 Corresponding Staff	辻本 壽 Tsujiimoto, Hisashi
研究代表者 Principal Researchers	執行 正義 (山口大学農学部) Shigyo, Masayoshi (Faculty of Agriculture, Tottori University)	
研究課題 Research Subject	耐乾性ニンニク系統の化学内容成分特性について Chemical component characteristic in drought resistance garlic clones	
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 Graduate School of Agricultural Sciences, Tottori University)	
共同研究要旨 Summary of Joint Research	<p>In the previous research, we evaluated growing traits of various garlic accessions collected worldwide in a trial field of the Arid Land Research Center, Tottori University and discovered several vigorous accessions which were able to adapt to arid condition. In this study, the same trials were carried out using 80 garlic accessions, including highly adaptable accessions, with a plastic greenhouse experimental plot. Moreover, in adaptable garlic accessions, some chemical production levels (AICSO, phenolic, and fructan content) in the bulbs were analyzed. Garlic accessions of greenhouse plot developed vigorous bulbs than that of field plot. Therefore, it was suggested that using a plastic greenhouse decreased several growth stresses. Additionally, in the chemical components of adaptable garlic accessions, both arid land plots showed significantly higher fructan content than was shown in normal conditions. From these results, it was suggested that these accessions stimulate fructan accumulation systems in order to adapt to arid land climate conditions.</p>	

一般研究 41 General Research 41	対応教員 Corresponding Staff	辻本 壽 Tsujiimoto, Hisashi
研究代表者 Principal Researchers	近江戸 伸子 (神戸大学人間発達環境学研究科) Omido, Nobuko (Graduate School of Human Development and Environment, Kobe University)	
研究課題 Research Subject	早期開花遺伝子を導入したジャトロファの特性に関する研究 Study for <i>Jatropha</i> Traits Introduced Early Flowering Transgene	
研究分担者 Co-researchers	秦 文香 (神戸大学人間発達環境学研究科) Hata, Ayaka(Graduate School of Human Development and Environment, Kobe University)	
共同研究要旨 Summary of Joint Research	<p>We have generated transformation <i>Jatropha</i> induced FLOWERING LOCUS T (FT) gene by agrobacterium methods and establish the effective transformation and culture methods. We changed the cocultivation medium condition from agar to filter paper medium. As the result, the surviving rate of in vitro culture explants on filter paper medium was higher than that on agar medium. Finally, the regenerated ratio is 10 %. 12 transformation shoots are regenerated and transferred to the rooting medium. In the next step, we will examine the efficient rooting condition and achieve the securing of rooting explants. For the basic genome analysis, <i>Jatropha meiosis</i> chromosome are analyzed by fluorescence in situ hybridization (FISH). We were able to confirm that gypsy-type Jg4 retrotransposon localization in the nuclear specific domain. Information about the transformed FT gene on <i>Jatropha</i> chromosome would give us the function of flowering regulation. These methods will contribute to develop the effective <i>Jatropha</i> breeding in future.</p>	

一般研究 42 General Research 42	対応教員 Corresponding Staff	安 萍 An, Ping
研究代表者 Principal Researchers	馬場 貴志 (鳥取大学農学部) Baba, Takashi (Faculty of Agriculture, Tottori University)	
研究課題 Research Subject	好塩性植物の窒素代謝及び光合成におけるナトリウムの役割 Role of sodium in nitrogen metabolism and photosynthesis in salt-loving plant species	
研究分担者 Co-researchers	藤山 英保 (鳥取大学農学部) Fujimiyama, Hideyasu (Faculty of Agriculture, Tottori University)	
共同研究要旨 Summary of Joint Research	In this study, we investigated the cultivation of 6 plant species to evaluate Na-dependence of plant species. As a result, plant cultivation using high Na ⁺ concentration water is possible and the optimal Na concentration for Kochia and Sugar beet was 120 and 80 mol m ⁻³ and Quinoa and Salsola was 40 mol m ⁻³ , respectively. On the other hand, Dry weight of spinach decreased with increasing Na concentration, which indicated that spinach was not salt-loving plant. However, the growth was not decreased at even 80 mol m ⁻³ Na. This result suggested that Spinach might be salt tolerant species.	

一般研究 43 General Research 43	対応教員 Corresponding Staff	岡本 昌憲 Okamoto, Masanori
研究代表者 Principal Researchers	轟 泰司 (静岡大学大学院農学研究科) Todoroki, Yasushi (Graduate School of Agriculture, Shizuoka University)	
研究課題 Research Subject	植物のストレス耐性を制御する新奇化合物の創出 Development of new chemicals for controlling stress tolerance in plants	
共同研究要旨 Summary of Joint Research	<p>Plant hormone abscisic acid (ABA) has critical roles in many physiological processes including seed dormancy, stomatal closure and adaptive responses to abiotic stress. Synthetic positive or negative regulators of ABA function are expected to use as not only chemical tools for research in plant biology but also plant growth regulators for agriculture application. We developed inhibitors of ABA-inactivating enzymes as the positive regulators and antagonists of ABA receptors as the negative regulators. (1) Specific inhibitors of ABA-inactivating enzymes: Key enzymes for ABA inactivation are ABA 8'-hydroxylases, cytochrome P450 enzymes classified into the CYP707A subfamily. We developed a new inhibitor of CYP707A, abscinazole-E3M, which was prepared at a lower cost than an existing CYP707A inhibitor abscinazole-E2B. Abscinazole-E3M enhanced ABA effects more greatly than abscinazole-E2B; it reduced transpiration and conferred drought tolerance in plants. (2) Antagonists of ABA receptors: ABA signaling is repressed by protein phosphatases 2C (PP2C), but stress-induced ABA binds PYL, which then bind and inhibit PP2C. On the basis of X-ray structures of several PYL-ABA and PYL-ABA-PP2C complexes, we designed and synthesized new inhibitors of PYL, PAN. These compounds functioned as more potent inhibitors of PYL than an existing PYL inhibitor AS6 and blocked multiple stress-induced ABA responses in vivo.</p>	

一般研究 44 General Research 44	対応教員 Corresponding Staff	岡本 昌憲 Okamoto, Masanori
研究代表者 Principal Researchers	三橋 渉 (山形大学農学部) Mitsuhashi, Wataru (Faculty of Agriculture, Yamagata University)	
研究課題 Research Subject	植物ホルモン・アブシジン酸による植物細胞周期新規制御機構の検討 Study of new regulation mechanism of cell cycle by a phytohormone, basics acid	
共同研究要旨 Summary of Joint Research	<p>Abscisic acid (ABA) is well known as a stress hormone in higher plants. When plants were transfer into dry condition, ABA levels increase to resistant to drought stress very quickly. However, ABA also works to reduce and stop growth. To recover the plant size in dry condition, we have to understand relationship between ABA signaling and cell growth.</p> <p>Last few years, I have been interested in a role of “inhibitor for cyclin dependent protein kinase (ICK)” that can arrest cell cycle. To clarify the new role of ICK, I tried to isolate novel binding protein against ICK. Finally, I isolated 3 independent genes from Arabidopsis thaliana whose translated proteins are able to bind to a member of kip-related proteins (KRPs) that are major family of plant ICK.</p>	

	<p>These three genes encode two of stress responsible protein and ABA related protein. It indicates that the ABA related protein may contribute to connect with cell cycle regulation via a KRP protein.</p> <p>In this work, at first, I decided the binding sites between the KRP and the ABA related protein, namely C-terminus of KRP could bind to N-terminus of the ABA related protein. And then, it was shown that binding capacity between the KRP and the ABA related protein in vitro. After ectopic expression of both proteins in Escherichia coli, a protein complex consisting with the KRP and the ABA related protein was observed after pull down assay. A database, BioGRID, shows that there is a new binding protein to the ABA related protein. Then, I tested whether the KRP, the ABA relate protein and new protein make a complex in vitro. After pulled down assay, each protein was detected on western blotted membrane.</p>
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一般研究 45 General Research 45	対応教員 Corresponding Staff	山中 典和 Yamanaka, Norikazu
研究代表者 Principal Re-searchers	増永 二之 (島根大学生物資源科学部) Masunaga, Tsugiyuki (Faculty of Life and Environmental Science, Shimane University)	
研究課題 Research Sub-ject	熱帯におけるイネの水分ストレスに対するケイ酸施用効果の実証的研究 Empirical study of silicate application effect on water stress of rice plant in tropical regions	
研究分担者 Co-researchers	シレガール アドハ ファトマ (島根大学生物資源科学部) Siregar Adha Fatmah (Faculty of Life and Environmental Science, Shimane University)	
共同研究要旨 Summary of Joint Research	<p>A rice cultivation experiment in combination with Si application and water treatments was conducted in Central Java, Indonesia. Rice growth, yield, Si content in stem and leaf, stomata size and density on matured leaf after booting stage (by SUMP method), δ 13C of flag leaf (in ALRC) were determined. On water condition, intermittent irrigation (Int, irrigated when water level reached -10cm from soil surface) treatment increased tiller number and grain yield comparing with submerged (Sub) and filed capacity (Fc) water condition. The δ 13C of flag leaf increased in Fc comparing with Int and Sub, which indicated no water stress happened in Int. Si application tended to increase grain yield and stomata density in Int. Gas exchange and photosynthesis efficiency might be improved, which possibly contribute to grain yield increase. Si content also increased in Int and this may reduce cuticular transpiration and improved grain filling rate. Si application did not clearly influence δ 13C content of flag leaves. Besides, Si application also improved lodging tolerance of the rice.</p> <p>In this study, the combination of intermittent irrigation and Si application improved rice water use efficiency and increased rice growth and yield, then it can be an effective option for rice cultivation technique in tropical regions suffering water shortage.</p>	

一般研究 46 General Research 46	対応教員 Corresponding Staff	山中 典和 Yamanaka, Norikazu
研究代表者 Principal Re-searchers	島田 章則 (麻布大学生命環境科学部) Tsuji, Yamato (School of Life and Environmental Science, Azabu University)	
研究課題 Research Sub-ject	地球温暖化がもたらすモンゴルの家畜の健康への影響 Effects of global warming on the health of domestic animals in Mongolia	
共同研究要旨 Summary of Joint Research	<p>Desertification, global warming and over population of the domestic animals induced the increase of plant poisoning and respiratory failure by sand dust in the Mongolian domestic animals including goats and sheep. Experimental pathological study using mouse and cattle renal epithelial cell culture demonstrated that plant extracts have some additional substances which enhance the toxic effects by swainsonine, major toxin of the plant <i>Oxytropis glabra</i>.</p> <p>In addition, field study showed the increase and extend of the plant poisoning and respiratory disorders by exposure to sand storm and by infectious agents including bacteria and virus. Ovine pulmonary adenomatosis was found to be prevailed in Mongolian domestic animals; the disease control is important to prevent the economic loss.</p>	

一般研究 47 General Research 47	対応教員 Corresponding Staff	山中 典和 Yamanaka, Norikazu
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研究代表者 Principal Researchers	三木 直子 (岡山大学大学院環境生命科学研究科) Miki, Naoko (Graduate School of Environmental and life, Okayama University)
研究課題 Research Subject	温帯性広葉樹における木部通水阻害の解消 Repair of xylem embolism in temperate broad-leaved tree species
研究分担者 Co-researchers	小笠 真由美 (東京大学大学院新領域創成科学研究科) 岩本 圭太 (岡山大学農学部) 川井 優宏 (岡山大学農学部) 秦 龍 (岡山大学大学院環境生命科学研究科) 佐藤 佳奈子 (岡山大学大学院環境生命科学研究科) 栗飯原 友 (岡山大学大学院環境生命科学研究科) Ogasa, Mayumi (Graduate School of Frontier Sciences, The University of Tokyo) Iwamoto, Keita (Faculty of Agriculture, Okayama University) Kawai, Masahiro (Faculty of Agriculture, Okayama University) Qin Long (Graduate School of Environmental and life, Okayama University) Aihara, Tomo (Graduate School of Environmental and life, Okayama University)
共同研究要旨 Summary of Joint Research	In angiosperm, rapid recovery from the drought-induced hydraulic failure is important for long-term maintenance of water transport under variable soil moisture condition and is believed to occur by refilling of embolized vessels. Recovery performance by refilling of vessel is different depending on the species, but what kind of physiological characteristics of the species-specific affects differences between species has not been revealed. As proposed by various authors, vessel refilling involves the flow of water into droplets on the cavitated vessel along an osmotic gradient generated by solutes released from the contact living cells. Therefore, it is expected that interspecies differences of recovery from refilling would be affected by physiological activity related to transport of solute and structural characteristics of the xylem, such as the distribution of parenchyma cells, which is important as a transport pathway. In this study, six temperate deciduous diffuse-porous species having the difference recovery performance were selected. The structural characteristics of the xylem, the physiological activity (maximum photosynthetic rate, soluble sugar content of stem) before and after dehydration (xylem water potential inducing 50% loss of hydraulic conductivity, Ψ_{50}) and the water potential at turgor loss point (Ψ_{wtlp}) were evaluated and the relationship between the recovery performance and these parameters was examined. As a result, the more soluble sugar content and the safety to turgor loss of leaves during dehydration (expressed by the difference between the Ψ_{50} and Ψ_{wtlp}) were high species recovery tended to be higher. These results suggested that interspecies difference of recovery from refilling was influenced by the characteristics related to the physiological activity than structural properties of xylem. The high soluble sugar content under dehydration condition caused by the high soluble sugar content before dehydration and the high leaf activity during dehydration could have resulted in transport of solute into droplets on the cavitated vessel.

一般研究 48 General Research 48	対応教員 Corresponding Staff	藤巻 晴行 Fujimaki, Haruyuki
研究代表者 Principal Researchers	高橋 一徳 (東北大学東北アジア研究センター) Takahashi, Kazunori (Center for Northeast Asian Studies, Tohoku University)	
研究課題 Research Subject	乾燥地における土壌・地下水環境監視のための新たな地中レーダ計測システムの開発 Advanced ground penetrating radar system for monitoring soil and ground water environment	
研究分担者 Co-researchers	佐藤 源之 (東北大学東北アジア研究センター) コヤマ クリスチャン (東北大学東北アジア研究センター) 黒田 清一郎 (農業・食品産業技術総合研究機構農村工学研究所) Sato, Motoyuki (Center for Northeast Asian Studies, Tohoku University) Koyama Christian (Center for Northeast Asian Studies, Tohoku University) Kuroda, Seiichiro (National Institute for Rural Engineering, National Agriculture and Food Research Organization)	
共同研究要旨 Summary of Joint Research	The project aimed at monitoring soils and ground water by ground penetrating radar and developed a technique to three-dimensionally estimate inclined subsurface layers. Conventionally, common-offset measurements which transmitting and receiving antennas scan together has been used, but it requires the full coverage of scan in the area. Moreover, the propagation velocity of waves must be assumed in the conventional way, which leads to error in the estimated structure. The proposed method estimates layers from two common mid-point measurements which changes the separation between antennas. Therefore, the method is faster and easier than the conventional way. Further, it can estimate propagation velocity at the same time, resulting in less estimation error. To validate and demonstrate the method, an experiment was carried out in the Arid Land Research	

	<p>Center. A reflector was buried in sand to simulate a layer interface and data were acquired in known condition. An additional measurement on natural subsurface layer in the center was also carried out. The data will be analysed and the method will be validated with the data.</p> <p>In addition a new radar system was investigated and designed for monitoring ground water by bore-hole radar technique which is effective for deeper underground. The system will be developed and tested to see the capability of ground water monitoring.</p> <p>Techniques and methods developed in the project would be useful for investigating soils and ground water in arid land; however, they cannot be applied only with GPR systems that Tottori University owns. Thus, discussions on the way to realize the ideas cooperating with Tohoku University and National Institute for Rural Engineering were hold and also field measurements were jointly carried out.</p>
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一般研究 49 General Research 49		対応教員 Corresponding Staff	伊藤 健彦 Ito, Takehiko
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	モンゴル草原における放牧圧の定量化と生態系への影響評価 Quantitative evaluation of grazing pressure and its effects on the ecosystem in Mongolian grasslands		
研究分担者 Co-researchers	飯島 慈裕 (独立行政法人海洋研究開発機構地球環境観測研究開発センター) Iijima, Yoshihiro (Research and Development Center for Global Change, Japan Agency for Marine-Earth Science and Technology)		
共同研究要旨 Summary of Joint Research	<p>The purpose of this study is to examine quantitatively the effects of livestock on plants, soil and carbon cycle in the semiarid grassland ecosystem. The study site was located in Bayan Unjuul county, Mongolia, which contains typical steppe vegetation that is grazed by livestock. In May 2015, we constructed a fence (10 m × 10 m) at the study site to prevent livestock from grazing and installed 4 interval cameras facing northward, eastward, southward, or westward at each corner of the fence. The images shot at intervals of 1 hour were stored from May to August. The meteorological parameters were also recorded every 30 minutes by a datalogger. In August 2015, we conducted the measurements of plant species composition, plant aboveground biomass, and CO₂ fluxes both inside and outside the fence. The species compositions were different between inside and outside the fence due to grazing, while the biomass in and out of the fence did not show a significant difference. The rates of photosynthesis and ecosystem respiration were slightly greater in the fence than out of that. The livestock such as sheep and goat were photographed at intervals of several days to one week. Using the images, we figured out an approximate number of animals which came to the study site during three months.</p>		

一般研究 50 General Research 50		対応教員 Corresponding Staff	小林 伸行 Kobayashi, Nobuyuki
研究代表者 Principal Researchers	苗川 博史 (東京農業大学教職・学術情報課程) Naekawa, Horofumi (Teacher Education and Scientific Information Course, Tokyo University of Agriculture)		
研究課題 Research Subject	モンゴル夏営地における動物福祉評価指標としての羊・山羊母子間の音声と行動 The vocalization and behaviour between sheep-goat mother and child as an animal welfare evaluation index in mongolia summer pasture		
研究分担者 Co-researchers	バタルチングイン ミヤクダダク (モンゴル国営事務局自然環境、食と農に関する部局) Batarchinguin Myakhdadag (Standing Committee on Nature Environment, Food and Agricultural, Secretariat of the State Great Hural of Mongolia)		
共同研究要旨 Summary of Joint Research	<p>The objective of this study was to scientifically investigate and evaluate the significance of separation calls and behavior during the separation of mother from child in sheep and goat while grazing in summer fields in Mongolia. Information elucidating this emotional response can be an objective indicator necessary for animal welfare assessment. Research was conducted in a summer field of nomads in Buruto district, Övörkhangaï Province, Mongolia, in August 2015. A total of four behavior types (roaming, roaming while grazing, grazing, and resting) were included for analysis of calls during 236 instances of separation of mother sheep and goat from lamb and kid, respectively, during day grazing.</p> <p>Although the behavioral trajectory of the sheep and goat groups was roughly the same, the proportion of resting and grazing behavior was significantly different between the two groups ($P < 0.05$).</p> <p>All animals except lambs rarely vocalized during grazing. During grazing, the visual attention of</p>		

	<p>both mother and lamb and kid was on grazing. Thus, mother and child were often separated. This is considered to be a reason why the animals vocalized.</p> <p>Time of vocalization was analyzed as an objective variable, whereas the fundamental frequency, sound pressure, and formant were analyzed as explanatory variables. The result demonstrated that the time of vocalization was significantly affected by formant in mother sheep and sound pressure in the mother goat and kids (multiple regression analysis, $P < 0.05$).</p> <p>Characteristics of acoustic variables between mother and lamb and kid were different based on the type of behavior. The intensity of the sound was different during roaming, roaming while grazing, and resting in lambs. It was also different at the time of roaming and resting in mother goats. These differences were significant ($P < 0.01$).</p> <p>In addition, while lactating and non-lactating, it was suggested that components of frequency and intensity of the sound may become important factors. We found that in situations where groups of sheep or goats were temporarily separated, their emotion-controlling behaviors included vocalizing and suckling or lactating until the groups joined again.</p> <p>This collaborative research provided us with an opportunity to present information that could not be obtained in individual studies and allowed interactions with researchers from different fields.</p>
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(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	黒崎 泰典 Kurosaki, Yasunori
研究代表者 Principal Researchers	大西 一成 (鳥取大学医学部) Onishi, kazunari (Faculty of Medicine, Tottori University)		
研究課題 Research Subject	黄砂・大気汚染物質濃度上昇現象の飛来経路・由来に関する分類 Classification of Asian dust and air pollution by origin and transport route		
共同研究要旨 Summary of Joint Research	<p>We collected data necessary for the identification of the event (Asian dust and Air pollution day). The environmental data which are open on WEB real time were very useful for our research. We installed the system that could download web data automatically. IMASORA(IMAGes from Sky Observation cameras for Research on Aerosol) is a system of the symptom questionnaire and a visibility investigation.</p> <p>We performed preliminary analyses of several measurements to assess the association between pollution and respiratory, nasal, ocular, skin, and other symptoms. Symptoms were self-evaluated using a web questionnaire scoring system and scores above 1 were defined as outcomes for this study. A generalized estimating equation was used for data analysis.</p> <p>These were correlated significantly with an intermediate correlation coefficient of $R = 0.369$ ($P = 0.003$).</p> <p>General estimating equation (logit link) was used for evaluating a risk of levoglucosan for measured subjective symptoms with adjustment for potential confounding factors. It showed a significant association of levoglucosan with an endpoint determined by reporting score 2 or more at least one symptom in any category, P trend = 0.024, OR of the highest quartile [Q4] vs. the lowest [Q1] = 1.84, 95%CI = 1.00 to 3.23). Levoglucosan was also significantly associated with nasal and respiratory symptoms in the same manner (P trend 0.016 and 0.036, respectively). The risk of symptoms in pregnant women increased with increasing levoglucosan concentrations. Our findings indicate that the risk of symptoms increased with the forest fire event on the continent; however, the causative agent that increased symptoms in the pregnant women is not clear from this study. In future studies, we will consider other potential confounders such as NO_2, SO_2, or weather conditions, and assess the interactions between multiple factors.</p>		
若手奨励研究 2 Incentive Research by Young Scientists 2		対応教員 Corresponding Staff	辻本 壽 Tsujiimoto, Hisashi
研究代表者 Principal Researchers	竹中 祥太郎 (龍谷大学農学部) Takenaka, Shotaro (Faculty of Agriculture, Ryukoku University)		

研究課題 Research Subject	4倍性コムギ・コアコレクションの耐乾性関連形質の評価 Evaluation of traits related to drought resistance in the tetraploid wheat core-collection
共同研究要旨 Summary of Joint Research	<p>In this study, we focused on abscisic acid (ABA), which is known as phytohormone related to environmental stress such as drought-resistance. ABA is present in common to all land plants and contributes to drought stress by promoting stomatal closure and/or accumulation various compatible solute. Therefore, ABA sensitive wheat is expected to be excellent in drought tolerance. The ABA sensitivity was evaluated by the ratio of shoot length with ABA treatment (0.25 μ M) to the length with non-ABA treatment. Because ABA sensitivity is influenced by the environments of seed production, we used seeds that were yielded this fiscal year.</p> <p>11 lines showed high sensitivity to ABA and its shoot growth was inhibited about 50% by ABA treatment. These 11 lines were all wild accessions. On the other hand, 7 lines were insensitive to ABA concentration level used in this study. These 7 lines included both wild and cultivated accessions.</p> <p>Finally, we did genotype-phenotype association analysis. And we detected some significant SNPs to ABA sensitivity on some chromosome arms (4BS, 5BS, 1AL, 7AL). The database of IWGSC suggested that a mRNA and significant SNPs on 4BS were positioned at the same contig sequence. BLAST search showed that the mRNA was homologous sequence of AK376067 of barley and growth-regulation factor 6 (Os03g0729500) of rice. A mRNA and significant SNPs on 5BS were also positioned at same contig sequence. The mRNA on 5BS was homologous sequence of AK371779 of barley. The mRNA codes DNA binding protein.</p>

若手奨励研究 3 Incentive Research by Young Scientists 3	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	乾燥ストレス下の作物における切葉による光合成向上機構の解明 Mechanism of enhancement of photosynthesis by defoliation in crops under drought stress	
共同研究要旨 Summary of Joint Research	<p>To develop appropriate crop cultivation technology which can increase grain yield under drought stress, we focused on “Ratio of root length to leaf area” which is one of the factors deciding water uptake in plants. It has been reported that increment of the ratio can enhance the hydraulic conductivity and stomatal conductance. So far, we found that photosynthetic rate per plant under drought stress increase when lower leaves with low transpiration efficiency are excised. Objectives of the present study are to evaluate photosynthetic rate per plant of sorghum and cowpea (representative cereal and legume crops in dryland defoliated with different magnitudes under several soil moisture conditions. In addition, the effects of defoliation on water use efficiency and grain yield are also investigated.</p> <p>Two plants of each crop species (sorghum and cowpea) were cultivated in a pot filled with sandy soil. At flowering stage, different levels of soil moisture treatments were started. Non-defoliated 10 plants (0% defoliation treatment) in each soil moisture treatment carried in “Cold desert simulator” in Arid Land Research Center. Afterward, Photosynthetic rate and transpiration rate per plant were evaluated for 12 hours by “chamber method” and “gravimetric method”, respectively. Same measurements were conducted for 20%, 40%, 60% and 80% defoliated plants in each soil moisture treatment.</p> <p>As the results, in both crop species, photosynthetic rate per plant decreased with increasing the magnitude of defoliation in relatively wet soil. In dry soil conditions, on the other hand, photosynthetic rate per plant increased with increasing the magnitude of defoliation, that is with decreasing leaf area. The most appropriate defoliation magnitude was higher in lower soil moisture. Transpiration rate and water use efficiency (photosynthetic rate/transpiration rate) showed almost similar trend with photosynthesis.</p> <p>In the field trial in rainfed area of Sudan, defoliated sorghum plants showed the tendency to increase grain yield under drought stress. These results suggest that defoliation has the potential to become new crop cultivation technology in drylands.</p>	

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
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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	モンゴル草原構成種の根の土壌貫入能力 ~種間差の解明と緑化への応用可能性~ Soil penetration ability of roots of plants in the Mongolian steppe: Investigation of inter-specific variation and applicability to revegetation
共同研究要旨 Summary of Joint Research	To propose plant species that are suitable for the revegetation on compacted soil in Mongolia, we first selected candidate species that have high root penetration ability, and then tested the growth of those species on compacted soil. The soil hardness that was penetrated by 50% of roots (P50, an index of root penetration ability) was highest in <i>Salsola collina</i> , with a P50 value of more than 90 times higher than that of the lowest species. Interspecific variation in root penetration ability was related to the plant succession at abandoned dirt tracks in the Mongolian steppe, which indicated that root penetration ability contributes to the vegetation recovery of compacted soils. Species with high root penetration ability, such as <i>S. collina</i> , <i>Bassia dasyphylla</i> , <i>Agrostis mongolicum</i> , and <i>A. frigida</i> were suggested as candidate species appropriate for vegetation recovery of compacted dirt tracks in the Mongolian steppe. When those species were grown on compacted soil, projected area of plant was larger in <i>A. frigida</i> , <i>B. dasyphylla</i> , and <i>S. collina</i> , indicating that those species are effective for reducing dust outbreak. Although <i>A. adamsii</i> and <i>A. frigida</i> required appropriate temperature and light for germination, <i>B. dasyphylla</i> and <i>S. collina</i> did not required them. Especially for <i>S. collina</i> , germination percentage was very high irrespective of environments, thus this species was thought to be appropriate for efficient revegetation. We concluded that <i>S. collina</i> is suitable for the revegetation on the compacted soil in Mongolia.

若手奨励研究 5 Incentive Research by Young Scientists 5	対応教員 Corresponding Staff	藤巻 晴行 Fujimaki, Haruyuki
研究代表者 Principal Researchers	徳本 家康 (佐賀大学農学部) Tokumoto, Ieyasu (Faculty of Agriculture, Saga University)	
研究課題 Research Subject	局所耕うん法を用いた密集根群分布による土壌の保水・吸水性の増加効果—乾燥地農業への適用と評価— Effect of High Root Density on Water Retention and Uptake using the Spot Drilling Method -Application and Evaluation of the Drilling Method to Arid Land Agriculture-	
共同研究要旨 Summary of Joint Research	<p>To evaluate water flow around high root density in a 20-cm long macro pore for the spot drilling method, we observed soil moisture, matric potential, evapotranspiration and plant root growth. Using an acrylic column experiment in a room temperature and light intensity controlled laboratory, the cultivation experiment was carried out. Two dimensional pressure head profile around the roots were measured by tensiometers. Water mass balance was evaluated successfully using soil moisture and evapotranspiration measurements. Our findings were:</p> <ol style="list-style-type: none"> 1. Soil moisture decreased near soil surface (soil depth from 0 to 7.5 cm) as evapotranspiration (5 · 6 mm/d) exceeded the amount of irrigation in 2 weeks after the young plant was transplanted. 2. During irrigation, we investigated ponding condition at the bottom of the 20-cm long artificial macro pore. This suggests preferential flow based on pressure head profiles. Within 6days from the seedling transplant, roots extended in the macro pore. After the period, however, root system developed along the wall of the macro pore. 3. In early stage of the root system growth, the root system tends to develop into the macro pore, suggesting that water flows into the macro pore preferentially through the roots. Also, water movement occurs along the wall of macro pore where root density is high. <p>We confirmed preferential flow in and around the macro pore, although development of high root density was not caused in the macro pore. To understand water use efficiency for crops with the spot drilling method, the relationship between root system growth and preferential flow would be important factor.</p>	

若手奨励研究 6 Incentive Research by Young Scientists 6	対応教員 Corresponding Staff	藤巻 晴行 Fujimaki, Haruyuki
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	樹木の水利用特性解明のための樹液流・樹体水分の同時測定センサーの開発 Development of a sensor for simultaneous monitoring of sap flow and stem water content for clarification of water use characteristics of trees
共同研究要旨 Summary of Joint Research	<p>The objective of this study was to develop a sensor for simultaneous monitoring of sap flow and stem water content to clarify water use characteristics of trees. We focused on Thermo TDR probe which is often used for monitoring of pollution materials in soil because this probe has both functions of hear pulse measurement and TDR (water content) measurement. A field experiment was conducted to monitor sap flow and stem water content using a sap flow sensor (SFM-1), a capacitance sensor (GS3) and a thermo TDR. The target tree was <i>Machilus thunbergii</i> in the campus of Tottori University.</p> <p>The results from the SFM-1 and GS3 probes showed that the stem water content decreased clearly with increase in the velocity of the sap flow, meaning simultaneous monitoring of sap flow and stem water content is important to clarify water use characteristics of trees. The results from the thermo TDR probe showed that this probe can be used to monitor sap flow. However, the monitoring accuracy of the stem water content by this probe was quite low. This is probably because the length of the probe was too short to monitor small variations in the stem water content. The variation of the bulk electrical conductivity in the stem measured by the GS3 probe was similar to the variation of the stem water content, suggesting that electrical conductivity sensors may be able to use to monitor stem water content. We have proposed the development of new sensor by combining electrical conductivity and sap flow sensors to ICT International Corporation.</p>

若手奨励研究 7 Incentive Research by Young Scientists 7		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) Kataoka, Ryota (Faculty of Life and Environmental Sciences, Yamanashi University)		
研究課題 Research Subject	生物的、物理的処理による塩類集積土壌での植物根の保護 Hybrid protection of plant root using bio-physio treatment in the salt accumulation soil		
共同研究要旨 Summary of Joint Research	<p>The soils in Turkey belonging to semi-arid zone have been deteriorated by salt accumulation. It is eager that soil will be remediated because of agro-productivity decrease. Kendirli et al. (2005) reported that a field beyond 1,500,000 ha already became soil salinization in Turkey. Pre-investigation of soil in the around of Aksaray university showed soil pH and EC were very high in the value of 8.8 ± 0.36 and 12.7 ± 2.45, respectively. In this study, therefore, high biofilm producing bacteria was screened from the rhizosphere soil of <i>Carex kobomugi</i> to protect plant roots from salt accumulation soil. According to the results of salt tolerant and exo-polysaccharide production of bacteria, <i>Achromobacter</i> sp. arid #2 was superior to other isolated strains. In addition, the permeability test of sodium ion was also conducted as follow. The diatomaceous earth was added to a syringe and incubated bacteria with PDB (pH 7, 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. Moreover activated charcoal as adsorbing material was also examined in the parallel trial. Although it was expected the effect of aid in the absorption of sodium by activated charcoal, there was no effect of activated charcoal on the permeability of sodium ion. However, the syringe with <i>Achromobacter</i> sp. arid #2 decreased permeability of sodium. Therefore, this strain may be the most effective and adaptive in the salt accumulation soil.</p>		

若手奨励研究 8 Incentive Research by Young Scientists 8		対応教員 Corresponding Staff	辻本 壽 Tsujiimoto, Hisashi
研究代表者 Principal Researchers	門田 有希 (岡山大学大学院環境生命科学研究科) Monden, yuki (Graduate School of Environmental and Life Science, Okayama University)		
研究課題 Research Subject	耐乾性育種に向けた、コムギ異種染色体添加系統におけるトランスポゾン MITE の遺伝解析 Genetic analysis of a miniature inverted-repeat transposable element (MITE) in wheat-Leymus racemosus added lines for wheat drought tolerance		
共同研究要旨 Summary of Joint Research	<p>In this year, we conducted the genetic analysis of the active miniature inverted-repeat transposable elements (MITEs) in wheat and the related species to provide insights for their exploitation in wheat molecular breeding. Several stowaway-like MITE families have been identified in wheat and related species. We investigated their insertion sites by designing 43 MITE primer pairs (selected from 13</p>		

	stowaway-like MITE families) in wheat accessions and related species. From the PCR analysis using those primers, it was shown that allohexaploid wheat species tend to have more insertions than tetraploid and diploid species, suggesting the possibility that some MITEs have undergone a recent and rapid activation after the formation of wheat. We also conducted preliminary DNA genotyping using several MITE SCAR markers in RIL mapping populations, resulting in integration of most of those markers into current linkage map. Interestingly, a high proportion of simplex allele was observed in those MITE markers, indicating their utility for linkage map construction in the polyploid species. Moreover, our experimental results suggested some MITEs may be still actively transposing in one wheat cultivar, named Norin 33, which is known as a genetically unstable cultivar. We are currently conducting the transposon display (TD) to investigate the detailed copy numbers and insertion polymorphisms of those MITEs in a number of wheat cultivars and strains (including alien chromosome introgression lines and RILs).
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若手奨励研究 9 Incentive Research by Young Scientists 9		対応教員 Corresponding Staff	エルタイプ・アミン Eltayeb Habora Amin
研究代表者 Principal Researchers	永野 惇 (京都大学生態学研究センター) Nagano, Atsushi (Center for Ecological, Kyoto University)		
研究課題 Research Subject	ステイグリーンソルガムの RNA-Seq による干ばつ耐性機構の研究 Transcriptomic analysis of the drought tolerance mechanism in the stay-green Sorghum		
共同研究要旨 Summary of Joint Research	<p>It is important to analyze RNA without a poly-A tail because transcription of plastid will have roles for the stay green trait and, recently, some non-coding RNA play a role in drought tolerance. The non-polyA RNA cannot be measured by conventional RNA-Seq library preparation method with oligo-dT beads purification. To analyze the non-polyA RNA, we employed the selective depression of rRNA method (Morlan et al., 2012) to our high-throughput library preparation system. In the selective depression of rRNA, rRNA were specifically degraded by anti-sense oligo DNA of rRNA and thermostable RNaseH. We analyzed leaf samples of <i>Oriza sativa</i> as a pilot analysis. Some photosynthesis related genes coded in the plastid genome used 70 - 90 % of the sequenced reads by the selective depression method, although reads derived from rRNA were suppressed less than few percent of total reads. To suppress reads from the photosynthesis gene, we designed anti-sense oligo DNA of the genes. Improvement of quantification efficiency was achieved by the suppression by the new anti-sense oligo DNA. The RNA-Seq method will be a powerful tool for reveal molecular mechanisms of the stay green trait in <i>Sorghum bicolor</i>.</p>		

若手奨励研究 10 Incentive Research by Young Scientists 10		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	植物種の消失が植物の生産性 と土壤微生物の活性に与える影響 The effects of plant species loss on plant productivity and soil microbial activity		
共同研究要旨 Summary of Joint Research	<p>The aim of this study is to predict the response of ecosystem functioning to predicted biodiversity loss by disaster in Mongolian grassland. In Mongolian grassland, the dominant perennial grass extinct first due to livestock grazing, and the rare species extinct first due to annual variety of rainfall. We thus tested four predicted plant species loss scenarios; 1) dominant species extinct first; 2) rare species extinct first; 3) mixture of scenarios 1 and 2, 4) and random extinction. We made experimental plots with different number of plant species by removing plants according to the scenarios in 2014 and examined ecosystem functioning in the plots 1 year after the removal.</p> <p>Our results predicted that litter decomposition rate and productivity would be decreased following drought and/or overgrazing.</p>		

(4) 研究集会/ Research Meeting

研究集会 1 Research Meeting 1	対応教員 Corresponding Staff	辻本 壽 Tsujiimoto, Hisashi
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研究代表者 Principal Re- searchers	松岡 由浩 (福井県立大学生物資源学部) Matsuoka, Yoshihiro (Department of Bioscience, Fukui Prefectural University)
研究課題 Research Sub- ject	コムギ遺伝資源の利活用に関する研究打ち合わせ：乾燥地での栽培特性の向上をめざして Use of wheat genetic resources for dryland farming
共同研究要旨 Summary of Joint Research	This meeting was held at Arid Land Research Center, Totori University, on September 1 and 2, 2015. Twenty-nine researchers/students from eight universities participated in the meeting. The goal of the meeting was to discuss how we could use wheat and Triticeae genetic resources to broaden the genetic diversity of modern cultivars in order to accelerate wheat breeding programs that counter global climate change and extreme environmental conditions including severe aridity. For this goal, two sessions were programmed: “Natural variations of agronomic traits in wheats” (day 1) and “How to broaden the genetic diversity of modern cultivars” (day 1 and 2). In the Natural variations of agronomic traits in wheats session, three talks on the genetic and geographic structures of phenotypic variations seen in wild/cultivated wheat and barley were given. In the How to broaden the genetic diversity of modern cultivars session, six talks reported the current status of artificial species cross, gene cloning, genomics analysis and highlighted the recent progress made in their applications. To conclude, the participants discussed what they could do to widen the genetic diversity of modern cultivars based on the latest technologies and resources and recognized the need for improved statistical approaches that enable to associate phenotypic and genetic variations with accuracy.

研究集会 2 Research Meeting 2	対応教員 Corresponding Staff	安 萍 An, Ping
研究代表者 Principal Re- searchers	森田 茂紀 (東京農業大学農学部) Morita, Shigenori (Faculty of Agriculture, Tokyo University of Agriculture)	
研究課題 Research Sub- ject	乾燥地における作物生産・生態系管理のための根のデザイン Designing roots for agricultural production and ecosystem management in arid and semi-arid areas	
研究分担者 Co-researchers	阿部 淳 (東海大学農学部) Abe, Jun (School of Agriculture, Tokai University)	
共同研究要旨 Summary of Joint Research	The symposium titled root design for crop production and ecosystem management in arid area was held Sept. 30, 2015 at Tokyo University of Agriculture welcoming around 200 participants. There was suggestive discussion to consider possible cooperative research on root design in arid area.	

1.4 国内外との交流 / Exchange Programs

(1) 学術交流協定 / Agreements of Academic Exchange and Cooperation

As of March 31, 2016

国名等 Country/Region	機関名	Names of Institutions
中国 China	北京林業大学	Beijing Forestry University
	北京師範大学	Beijing Normal University
	新疆農業大学	Xinjiang Agricultural University
	蘭州大学	Lanzhou University
	中国科学院水利部水土保持研究所	Institute of Soil and Water Conservation, CAS and MWR
	中国科学院遺伝及び発育生物学研究所 農業資源研究センター	Center for Agricultural Resources Research, Institute of Genetics and Developmental Biology, CAS
	中国科学院寒区旱区環境工学研究所	Cold and Arid Regions Environmental and Engineering Research Institute (CAREERI), CAS
	中国林業科学研究院	Chinese Academy of Forestry
モンゴル Mongolia	気象水文環境情報研究所	Information and Research Institute of Meteorology, Hydrology and Environment
	モンゴル科学アカデミー一般及び実験生物学研究所	Institute of General and Experimental Biology, Mongolian Academy of Sciences
レバノン Lebanon	国際乾燥地農業研究センター	The International Center for Agricultural Research in the Dry Areas (ICARDA)
イスラエル Israel	エルサレム・ヘブライ大学ロバート H. スミス農業食料環境学部	The Robert H. Smith Faculty of Agriculture, Food and Environment, the Hebrew University of Jerusalem
スーダン Sudan	スーダン農業研究機構	Agricultural Research Corporation
	ハルツーム大学	University of Khartoum
チュニジア Tunisia	乾燥地域研究所	Arid Regions Institute
エチオピア Ethiopia	バハルダール大学	Bahir Dar University
メキシコ Mexico	国立農牧林業研究所	National Institute of Forestry, Agricultural and Animal Research (INIFAP)
イタリア Italy	バーリ地中海農学研究所	The Mediterranean Agronomic Institute of Bari (CIHEAM-Bari)

(2) 国際共同研究

ゴビ砂漠の詳細観測に基づく黄砂-地表面過程モデルの構築

期間：2015年4月-2019年3月

代表者：黒崎泰典（鳥取大学乾燥地研究センター）

組織：鳥取大学（黒崎泰典、西原英治、中村公一）・香川大学（石塚正秀）・気象庁気象研究所（関山剛、眞木貴史、田中泰宙）・モンゴル気象水文環境情報研究所（D. Jugder、B. Buyantogto、B. Gantsetseg）

研究費：科学研究費 基盤研究（B）

課題：地表面-黄砂発生過程の多くを組み込むことができていないため、既存の黄砂数値モデルは精度不足の問題を抱えている。これまでの観測から、(1)クラスト形成・崩壊、(2)レキの量、(3)窪地、(4)植生量を考慮していないことが原因で、黄砂数値モデルが現実の黄砂を再現出来ていないことが定性的に明らかになっている。本研究では設置済みの観測資源を活用して、クラスト、レキ、窪地、植生といった地表面条件を定量化し、この結果に基づいた黄砂-地表面過程モデルの構築を目標とする。

環境の予測可能性と不均一性を組み込んだモンゴルの野生動物保全上の重要地域検出

期間：2015年4月-2018年3月

代表者：伊藤健彦（鳥取大学乾燥地研究センター）

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一般及び実験生物学研究所（B. Lhagvasuren）

研究費：科学研究費 基盤研究（C）

課題：野生哺乳類の大移動がみられるモンゴル草原では開発による生息地分断化の影響が危惧されている。環境条件の地域差を考慮した保全対策の提言を目的とし、環境の予測可能性や不均一性を解析に組み込んで、長距離移動動物の移動・生息地選択要因と、生息適地や保全上の重要地域を明らかにする。

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

期間：2013年10月-2018年3月

代表者：恒川篤史（鳥取大学乾燥地研究センター）

組織：鳥取大学（恒川篤史、Dagnachew Aklog、藤春晴行）、島根大学（増永二之）、パハルダール大学（Enyew Adgo, Derege Meshesha）、(O. Radwan)、南アフリカ土壤・気候・水研究所（坪充）

研究費：科学研究費 基盤研究（A）海外学術調査

課題：エチオピアの青ナイル川流域では、土壌侵食と土壌流亡が土地生産力の低下に深刻な影響を与えている。そして、青ナイル川上流域の土壌流亡は、下流域のスーダンとエジプトのダム土砂堆積の原因であることから、国際的な環境問題でもある。青ナイル川上流域における水食問題の緩和には、住民参加による持続可能な土地管理が不可欠であるが、そのためには土地管理施策の効果・影響を解明することがまず必要である。そこで、本研究では、ナイル川流域全体に配慮する最適な土地管理対策のガイドラインを検討するために、(1) 青ナイル川上流域の持続可能な土地管理技術の効果および(2) 上流域の土地管理対策が下流域の水資源に及ぼす影響の評価を行い、(3) 持続可能な

(2) International Joint Research

Building a model of processes between land surface and dust emission based on detailed observations in the Gobi Desert

Period: Apr. 2015- Mar. 2019

Leader: Y. Kurosaki (ALRC, Tottori University)

Organization: Tottori University (Y. Kurosaki, E. Nishihara, K. Nakamura), Kagawa University (M. Ishizuka), Meteorological Research Institute, Japan Meteorological Agency (T. T. Sekiyama, T. Maki, T. Y. Tanaka) and Information and Research Institute of Meteorology, Hydrology and Environment (D. Jugder, B. Buyantogto, B. Gantsetseg)

Funding: JSPS Grants-in-Aid for Scientific Research (B)

Subject: Existing dust numerical models have an accuracy problem because it still cannot include many processes between land surface and dust emission. From our observations, we have qualitatively clarified that key factors in aeolian erodibility are (1) formation and breakdown of soil crust, (2) amount of gravels, (3) topographic depression, and (4) vegetation amount. In this research, we aim to quantify the effect of land surface conditions on dust emission such as soil crust, gravel, topographic depression and vegetation by utilizing our dust observation system already installed in the Gobi Desert, and we also aim to build a numerical model installing these processes.

Detection of important areas for wildlife conservation in Mongolia considering environmental predictability and heterogeneity

Period: Apr. 2015- Mar. 2018

Leader: T. Ito (ALRC, Tottori University)

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

Funding: JSPS Grants-in-Aid for Scientific Research (C)

Subject: Influences of habitat fragmentation of wild mammals are concerned in Mongolia's grasslands. To propose conservation strategies for the wildlife and ecosystem, we examine factors on movements and habitat selection of long-distance movement animals and detect important areas for conservation by considering regional differences, predictability and heterogeneity of environmental conditions.

Land management to mitigate soil erosion in the upper Blue Nile River Basin

Period: Oct. 2013- Mar. 2018

Leader: A. Tsunekawa (ALRC, Tottori University)

Organization: Tottori University (A. Tsunekawa, D. Aklog, H. Fujimaki), Shimane University (T. Masunaga) and Bahir-Dar University (E. Adgo, D. Meshesha)

Funding: JSPS Grants-in-Aid for Scientific Research (A)

Subject: Soil erosion by water is the largest degradation agent and makes Ethiopia major water and sediment "exporter" to downstream countries. The objectives of the research are (1) evaluation of the effects of soil erosion measures with respect to soil erosion and land productivity in the upper Blue Nile River Basin, (2) evaluation of the effects of the soil erosion measures in the upper Blue Nile River Basin on the sedimentation and water resources of Sudan and Egypt in the lower Blue Nile River Basin, and (3) identification of the most suitable technologies to mitigate soil erosion, and development of a decision support system for the optimum allocation of water resources and land management.

土地管理のための意思決定支援システムを開発する。

ステイ・グリーンの遺伝的メカニズムの解析と耐乾性ソルガム育種への応用

期間：2015年7月－2017年6月

代表者：Eltayeb Amin（鳥取大学乾燥地研究センター）

組織：鳥取大学乾燥地研究センター（Eltayeb Amin）

スーダン・農業研究機構（Izzat S. A. T.）

研究費：日本学術振興会 二国間交流事業共同研究

課題：ソルガムはスーダンの食糧保障を担う主要な穀物である。ソルガムは主に天水栽培によって生産されるが、雨季終期にはしばしば雨量の減少や干ばつが起こる。これにより、ソルガムの生産量が減少し、スーダンの食糧の保障が脅かされている。本研究の目的は、水不足状況下での作物の成長や生産量維持に寄与する重要な遺伝子を同定することである。本年度は、2月にスーダン・農業研究機構において本研究に国際研修会を開催し、これに参加した日本やスーダンの科学者たちは研究内容や共同研究についての情報交換を行った。

中国極乾燥地民勤オアシスにおける環境保全型農業の生産性向上に関する研究

期間：2015年4月－2017年3月

代表者：柏木純一（北海道大学）

組織：北海道大学（柏木純一）・鳥取大学乾燥地研究センター（安萍）・北海道総合研究機構（岡元英樹）

研究費：鳥取大学乾燥地研究センター 共同研究

課題：不適切な農業開発により、中国民勤オアシスの環境・生態系は大きく破壊され、砂漠化が加速し、オアシスは存続の危機に直面している。このプロジェクトは、民勤の問題にピンポイントで対処するため、以下の3つの実践的な研究課題を掲げ、これらの解明を通じて、民勤オアシスの環境保全と持続的農業経営を両立させることを目的とする。1) 現地環境に適した節水型作物育種のための形質の特定 2) 塩性土壌を利用した経済価値の高い耐塩性植物の栽培 3) 牧草生産を高めるための牧草の耐乾性機構の解明。

モンゴル現地実験と冷涼帯砂漠シミュレータによる土壌表層のクラスト形成過程の解明

期間：2015年4月－2017年3月

代表者：石塚正秀（香川大学）

組織：香川大学（石塚正秀）・鳥取大学（黒崎泰典、西原英治、中村公一）・理化学研究所（山田豊）・気象業務支援センター（三上正男）・モンゴル気象水文環境情報研究所（D. Jugder, B. Gantsetseg）

研究費：鳥取大学乾燥地研究センター 共同研究

課題：乾燥地から強風により発生する鉱物性ダスト粒子は、大気中を長距離にわたり輸送され、気候、様々な地球環境に影響していることが知られており、人や家畜の健康への影響も懸念されている。ダストのこれらへの影響を明らかにするためにはダスト発生量の正確な見積りが必須であるが、ダスト発生の時間変化（経年および季節変化）および空間変化の再現の精度には課題が残っている。2012年に我々が実施したモンゴルのゴビ砂漠で行った観測は、クラストの黄砂発生への多大な影響を示唆していた

Identification of the genetic mechanism of Stay-Green trait, and its application for breeding drought tolerant sorghum

Period: Jul. 2015- Jun. 2017

Leader: Eltayeb Amin (ALRC, Tottori University)

Organization: ALRC, Tottori University (Eltayeb Amin), Agricultural Research Corporation, Sudan (Izzat S. A. T.)

Funding: JSPS Bilateral Joint Research Projects

Subject: Sorghum is the major food security crop in Sudan. It is cultivated mainly under rainfed conditions, where reduction on rainfall and drought occur often at the end of the season. This situation leads to severe reduction on sorghum production and often put the Sudanese food security at crises. This project aims at discovering important genes that function on keeping the plants green and productive even under water shortage conditions. During this year, an international workshop on this topic was held on February in the ARC of Sudan, where Japanese and Sudanese scientists gathered and exchanged about research progress and collaboration.

Study for agricultural productivity improvements based on environmentally-friendly farming systems in arid oasis, Minqin in China

Period: Apr. 2015- Mar. 2017

Leader: J. Kashiwagi (Hokkaido University)

Organization: Hokkaido University (J. Kashiwagi), ALRC, Tottori University (P. An), Hokkaido Research Organization (H. Okamoto) and Cold and Arid Regions Environmental and Engineering Research Institute (CAREERI), Chinese Academy of Sciences (CAS) (X. Xue, C. Huang)

Funding: ALRC Joint Research

Subject: Minqin Oasis is facing serious environmental and ecological problems, which have been threatening the daily life of the local people. This project is to solve these problems in Minqin so as to establish an environmentally conserved oasis with a sustainable agriculture development. To reach the objectives, following three subjects are conducting. 1) Identification of the characteristics of local crops for breeding water-saving varieties. 2) Cultivation of high salt tolerant species with high economic value using local saline soils. 3) Investigation of drought tolerant mechanisms of local pastures for increasing pasture production.

Study on soil crust formation by field experiment in Mongolia and dryland simulation systems for cold desert

Period: Apr. 2015- Mar. 2017

Leader: M. Ishizuka (Kagawa University)

Organization: Kagawa University (M. Ishizuka), Tottori University (Y. Kurosaki, E. Nishihara, K. Nakamura), RIKEN (Y. Yamada), Japan Meteorological Business Support Center (M. Mikami), and Information and Research Institute of Meteorology, Hydrology and Environment (D. Jugder, B. Gantsetseg)

Funding: ALRC Joint Research

Subject: Mineral dust particles, which emitted by strong winds from arid lands, travel for a long distance in the atmosphere. It is well known that their effects on climate and a variety of global environment are not negligible. We also have a concern of the health effect of them. An accurate estimate of dust emission amount is essential to evaluate their effects. However, we still have a problem in an accuracy in a reproduction of temporal (i.e., inter-annual and seasonal) and spatial variations of dust emission. Our observation carried out in the Mongolian Gobi Desert on

(Ishizuka et al. 2012)。2013・14年は同サイトにおいて、クラスト強度や水分浸透特性の簡易実験を実施したが、クラストの形成機構については未解明なままである。本研究では、ゴビ砂漠観測サイト付近の気象と土壌状態を想定して、デザートシミュレータと降雨シミュレータを用いて、降雨によるクラスト形成機構の解明を目的とし、土壌クラストが黄砂発生に与える影響を明らかにする。

中国甘肅省におけるシンメンタル種肉用牛のエネルギー・窒素出納に及ぼすアルファルファ給与の効果

期間：2015年5月–2016年11月

代表者：F. Hou (Lanzhou University)

組織：中国蘭州大学 (F. Hou)・鳥取大学乾燥地研究センター (恒川篤史、小林伸行)

研究費：鳥取大学限界地プロジェクト、中国国家重点科学技術支援プログラム、中国国家自然科学基金、中国大学長江先端的研究プログラム

課題：中国では、牛肉消費量の急増に伴う飼料給与量の抑制のため、飼料の効率的な利用体系の構築が求められる。同国肉用牛生産の重点地域である甘肅省において一般的に播種・栽培され、タンパク質含量や耐旱性が高いアルファルファは、肉用牛飼料としての有用性が高いと考えられる。本研究では、肉用牛の飼養法改善の方策の1つとして、アルファルファ乾草で濃厚飼料を代替した際の増体成績およびエネルギー出納成績に及ぼす影響を検討する。

パレスチナ西岸地区におけるウォーターハーベスティングによる食料安全保障の強化

期間：2014年6月–2016年3月

代表者：藤巻晴行

組織：ナジャハ大学・東京大学・新潟大学・鳥取大学

研究費：日本学術振興会 二国間交流事業共同研究

課題：パレスチナ西岸地区における食料安全保障の強化のため、キャピラリーバリアとビニールシートを用いたウォーターハーベスティングの可能性を土壌水分観測と流出観測および自動灌漑実験により評価する。

乾燥地における非均一性土壌中の移動現象

期間：2014年5月–2016年3月

代表者：R. Berndtsson (Lund University)

組織：ルンド大学(R. Berndtsson, M. Persson)・鳥取大学乾燥地研究センター(安田裕)・ポートサイド大学(Y. Hamed)、中国科学院寒区旱区環境工学研究所(X. Wang)

研究費：Minor Field Study by Swedish International Development Authority (SIDA), the MECW project at the Center for Middle, Eastern Studies, Lund University.

課題：乾燥地の土壌は非均一性が強く移動現象をダイナミクスで評価することは困難である。本件研究にあって、エジプト北東部で浸透実験が実施され、結果をフラクタルの一種である Diffusion limited aggregation (DLA)モデルで解析した。モデルパラメータの最適同定には遺伝子アルゴリズムが用いられた。移動現象は著しい非均一性を呈していた。また、土壌特性により、移動現象は大きな差異を示していたので、ダイナミクスモデルでは評価不能であったが、DLAにより断面平均浸透を再現できた。今回は中国で実

2012 suggests a significant effect of soil crust on dust emission (Ishizuka et al., 2012). We carried out simple experiments to measure hardness and water infiltration characteristics of crust at the observation site on 2013 and 2014, but we still have not clarified the mechanism of crust formation. In our research, we aim to clarify the mechanism of crust formation after rain fall and the effect of crust on dust emission using dryland simulation system and rainfall simulation system installed in ALRC assuming meteorological and soil conditions around our observation site in the Gobi Desert.

Effect of alfalfa hay feeding on energy and nitrogen utilization of Simmental beef cattle kept in Gansu Province, China

Period: May 2015- Nov. 2016

Leader: F. Hou (Lanzhou University)

Organization: Lanzhou University (F. Hou) and ALRC, Tottori University (A. Tsunekawa, N. Koayashi)

Funding: Marginal Region Agriculture Project of Tottori University, National Key Project of Scientific and Technical Supporting Programs of China, National Natural Science Foundation of China, Program for Changjiang Scholars and Innovative Research Team in University of China

Subject: In china, in order to prevent the increase of feeding amount for beef cattle caused by the increasing consumption of beef meat, the establishment of system to efficiently utilize feed is required. In Gansu Province, one of the prioritized area for beef cattle production, the ‘pen feeding’ is under development and the alfalfa, generally sown and cultivated in the Province, can be utilized as the feed of beef cattle, since it is high in the protein content and the resistance against drought. This research aims to study the effect of replacement of concentrate with alfalfa hay on body weight daily gain and energy metabolism.

Enhancing food security using water harvesting in West Bank of Palestine

Period: Jun. 2014 – Mar. 2016

Leader: Haruyuki Fujimaki (ALRC, Tottori University)

Organization: An-Najah University, Tokyo University, Niigata University, Tottori University

Funding: JSPS Bilateral Joint Research Projects

Subject: To enhance food security of Palestine, feasibility of new water harvesting method, capillary barrier and water harvesting using plastic sheet, is evaluated by monitoring how much water is lost due to surface runoff and deep percolation and by performing an automatic irrigation experiment.

Transportation in heterogeneous soil in arid land.

Period: May 2014- Mar. 2015

Leader: R. Berndtsson (Lund University)

Organization: Lund University (R. Berndtsson, M. Persson), ALRC Tottori University (H. Yasuda), Portside University (Y. Hamed), Cold and Arid Regions Environmental and Engineering Research Institute (CAREEI), Chinese Academy of Science (X. Wang).

Funding: Minor Field Study by Swedish International Development Authority (SIDA), the MECW project at the Center for Middle, Eastern Studies, Lund University.

Subject: Since heterogeneity of soil property is so predominant in arid land, transport phenomena is difficult to be evaluated by dynamic models. In this study infiltration experiments were

施予定である。

パレスチナにおける下水処理水および脱塩処理水を利用した熱帯果樹栽培

期間：2014年4月－2016年3月

代表者：竹内真一 南九州大学 准教授

組織：国立農業研究所・南九州大学・弘前大学・鳥取大学
研究費：鳥取大学乾燥地研究センター 共同研究

課題：パレスチナ西岸地区における食料安全保障の強化のため、下水処理水および脱塩処理水を利用した熱帯果樹栽培の可能性を現地栽培実験により評価する。また、灌漑における適切な灌水基準サクションを探索する。

中国黄土高原半乾燥地における森林の水利用及び物質循環

期間：2014年4月－2016年12月

代表者：山中典和（鳥取大学乾燥地研究センター）・S. Du
（中国科学院水土保持研究所）

組織：鳥取大学乾燥地研究センター（山中典和、谷口武士）、
京都大学（館野隆之輔、岩岡史恵）・九州大学（大槻恭一）・
中国科学院水土保持研究所（S. Du, M. Yan, Q. He, Q. Tian,
R. Cheng, J. Yue）

研究費：日本学術振興会 二国間交流事業共同研究

課題：中国黄土高原の半乾燥地において、森林の水利用及び物質循環の解明を目指した研究を行っている。今年度は塩類集積地における土壌中のナトリウム及び窒素分布に与える塩生植物タマリスクの影響を明らかにした。

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

期間：2012年4月－2016年3月

代表者：安田裕（鳥取大学乾燥地研究センター）

組織：鳥取大学乾燥地研究センター（安田裕、井上知恵）・
鳥取大学農学部（齋藤忠臣、辻渉）、スーダン環境省砂漠化
研究所（T.E. Gamri, M.A.M. Elbasit Ahmed）

研究費：科学研究費 基盤研究（B）

スーダンで外来侵入樹種メスキートと地下水文系との関連につき調査を行った。メスキートにより、地下水位は毎日日に数cm低下していた。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ので、地下水位変動はダブルピークになっていた。

conducted in the northeastern Egypt and results were analyzed by a Diffusion Limited Aggregation (DLA) model, one of fractal model. For the optimization of the parameters the Genetic Algorithm was applied. The transportation process indicated apparent heterogeneity. There were great different on the transportation phenomena due to soil properties. The DLA model reconstructed the infiltration in the horizontal average. Infiltration in sandy type soil is interesting. Next time, the experiment should be conducted in China.

Tropical fruit tree cultivation using sewerage treatment water and desalination processing water in Palestine

Period: Apr. 2014 – Mar. 2016

Leader: Shinichi Takeuchi (Minami-Kyushu University)

Organization: National Agricultural Research Center of Palestine, Minami-Kyushu University, Hirosaki University, Tottori University

Funding: ALRC Joint Research

Subject: To enhance food security of Palestine, feasibility of cultivation of tropical fruit using treated waste water and desalinated water is evaluated. Also, appropriate trigger suction for irrigation is examined.

Water use and nutrient cycling in typical forests of the semi-arid Loess Plateau, China

Period: Apr. 2014- Dec. 2016

Leader: N.Yamanaka (ALRC, Tottori University), S. Du (ISWC, Chinese Academy of Sciences)

Organization: ALRC Tottori University (N.Yamanaka, T. Taniguchi), Kyoto University (R. Tateno, T. Iwaoka), Kyushu University (K.Otsuki), ISWC, Chinese Academy of Sciences (S. Du, M. Yan, Q. He, Q. Tian, R. Cheng, J. Yue)

Funding: JSPS Bilateral Joint Research Projects

Subject: We conducted field researches on water use and nutrient cycling in typical forests of the semiarid loess plateau, china, and the effects of halophytic plants (*Tamarix austromongolica*) on salt and nitrogen distribution in salt accumulated areas are elucidated.

Relationship between alien invasive plant, mesquite and subsurface hydrology in arid environments

Period: Apr. 2012- Mar. 2016

Leader: H. Yasuda (ALRC, Tottori University)

Organization: ALRC, Tottori University (H. Yasuda, T. Inoue), Faculty of Agriculture, Tottori University (T. Saito, W. Tsuji) and Desertification Research Institute, the Ministry of Environment, Sudan (T. E. Gamri, M.A.M. Elbasit Ahmed)

Funding: JSPS Grants-in-Aid for Scientific Research (B)

Subject: In arid Sudan, relationship between alien invasive plant, mesquite and subsurface hydrology was studied. By water uptake by mesquite, groundwater level reduced several cm in daytime. Since the water uptake was ceased around the noon when the solar radiation is the maximum, diurnal fluctuation of groundwater level indicated double peak pattern.

(3) 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
黒崎 泰典 Kurosaki, Yasunori	モンゴル Mongolia	Apr. 14– May 2, 2015	黄砂発生メカニズムの解明に関する観測及び研究打合せ An observation for elucidation of dust emission mechanisms and a research meeting	黄砂プロジェクト Project Asian Dust
	モンゴル Mongolia	Jun. 10– 21, 2015	黄砂発生メカニズムの解明に関する観測及び研究打合せ An observation for elucidation of dust emission mechanisms and a research meeting	黄砂プロジェクト Project Asian Dust
	モンゴル Mongolia	Feb. 25– Mar. 12, 2016	研究打合せ、土壌 GIS データについての聞き取り調査、黄砂観測サイトのメンテナンス A research meeting, a hearing investigation about GIS data for Mongolian soil, and a maintenance of the dust monitoring site	鳥取大学国際乾燥地研究教育機構 International Platform for Dryland Research and Education (IPDRE) of Tottori University (TU)
安田 裕 Yasuda, Hiroshi	ミャンマー Myanmar	Aug. 27– Sep. 5, 2015	ミャンマー中部乾燥地における植林に関する水環境に係る現地調査 Field survey on water environment for afforestation in the central arid zone of Myanmar	鳥取大学大学院連合農学研究科 The United Graduate School of Agricultural Sciences of TU
	スウェーデン Sweden	Sep. 13– 22, 2015	乾燥環境における水収支の定量的解析に関する国際共同研究 International collaboration research on quantitative analysis of water budget in arid environments	私費 Private fund
	ミャンマー Myanmar	Mar. 3–9, 2016	ミャンマー中部乾燥地における農村開発に関する水環境に係る現地調査 Field survey on aqua environment for rural development in the central dry zone, Myanmar	寄附金 Subsidy from a private firm
	スーダン Sudan	Mar. 11– 16, 2016	国際会議出席 Participation in the First Khartoum Environmental Conference on Green Belt Implementation	鳥取大学国際乾燥地研究教育機構 IPDRE of TU
恒川 篤史 Tsunekawa, Atsushi	中国 China	May 1– 10, 2015	研究打合せ Research Meeting	日本学術振興会 Japan Society for the Promotion of Science (JSPS)
	エチオピア Ethiopia	Jul. 3–16, 2015	共同研究に関する現地調査及び研究打合せ Meeting and field survey for collaborative research	日本学術振興会 JSPS
	エチオピア Ethiopia	Oct. 2–9, 2015	共同研究及び SATREPS 申請に関する打合せ Meeting for collaborative research and SATREPS submission	日本学術振興会 JSPS
	トルコ Turkey	Oct. 10– 18, 2015	UNCCD COP12 参加 Attendance at UNCCD COP 12	環境省 Ministry of the Environment
	メキシコ Mexico	Jan. 27– Feb. 1, 2016	共同研究打合せ及び試験場見学 Meeting for collaborative research and inspection of experiment stations	日本学術振興会 JSPS
	オーストラリア Australia	Mar. 19– 26, 2016	共同研究打合せ及び視察 Meeting for collaborative research and on-site inspection	鳥取大学国際乾燥地研究教育機構 IPDRE of TU

氏名 Name	国名 Country	期間 Period	用務内容 Purpose	経費 Fund
安 萍 An, Ping	中国 China	Jul. 29– Aug. 14, 2015	共同研究打合せ及び調査 Meeting and field survey for collaborative research	運営費交付金 Cooperative Research Program of ALRC
辻本 壽 Tsujimoto, Hisashi	タイ Thailand	Apr. 28– May 3, 2015	第 5 回アジア染色体コロキウム参加 Attendance at the 5th Asian Chromosome Colloquium	鳥取大学国際乾燥地研究 教育機構 IPDRE of TU
	スーダン Sudan	May 21– 29, 2015	共同研究打合せ Meeting for collaborative research	限界地プロジェクト Project Marginal Region Agriculture
	イタリア Italy	Jun. 2–6, 2015	小麦イニシアティブ第 5 回研究委員会等参加 Attendance at the 5th Research Committee of the International Research Initiative for Wheat Improvement	国際農林水産業研究セン ター Japan International Research Center for Agricultural Sciences (JIRCAS)
	インド India	Jul. 7–11, 2015	限界地プロジェクトに係る研究打合せ及び ICRISAT 施設視察 Meeting and inspections of ICRISAT facilities under the Project Marginal Region Agriculture	運営費交付金 Cooperative Research Program of ALRC
	中国 China	Aug. 4– 19, 2015	ムギ類植物遺伝資源の学術調査 Exploration of wheat and barley germplasm	岡山大学 Okayama University
	カタール Qatar	Sep. 15– 20, 2015	カタールプロジェクトに係る共同研究 Collaborative research on Qatar Project	カタール大学 Qatar University
	オースト リア Austria	Oct. 8– 10, 2015	共同研究打合せ Meeting for collaborative research	鳥取大学国際乾燥地研究 教育機構 IPDRE of TU
	トルコ Turkey	Oct. 11– 16, 2015	UNCCD COP12 の展示及びサイドイベント参加 Participation in the exhibitions and side events of UNCCD COP12	鳥取大学国際乾燥地研究 教育機構 IPDRE of TU
	トルコ Turkey	Oct. 31– Nov. 9, 2015	第 2 回国際育種学会議招待講演 Invited lecture in the 2 nd International Breeding Congress	限界地プロジェクト Project Marginal Region Agriculture
スーダン Sudan	Feb. 14– 21, 2016	国際ワークショップにおける共同研究打合せ及 び現地調査 Holding the 1 st International Workshop on Genetic Improvement of Cereals For Sustainable Production in Arid Lands in the ARC, discussion of the collaborative research and field survey	日本学術振興会 JSPS	
エリタイプ ハボラ E. アミン Eltayeb Habora, E. Amin	インド India	Jul. 7–11, 2015	限界地プロジェクトに係る研究打合せ及び ICRISAT 施設視察 Meeting and inspections of ICRISAT facilities under the Project Marginal Region Agriculture	限界地プロジェクト Project Marginal Region Agriculture
	オースト リア Austria	Nov. 23– 29, 2015	IAEA との共同研究打合せ Meeting for collaborative research with the Plant Breeding and Genetics Laboratory of the International Atomic Energy Agency	限界地プロジェクト Project Marginal Region Agriculture
	アメリカ 合衆国 USA	Jan. 8–15, 2016	国際学会出席 Attendance at the International conference Plant and Animal Genome XXIV	限界地プロジェクト Project Marginal Region Agriculture

氏名 Name	国名 Country	期間 Period	用務内容 Purpose	経費 Fund
エリタイプ ハボラ E. アミン Eltayeb Habora, E. Amin	スーダン Sudan	Feb. 14- 21, 2016	国際ワークショップにおける共同研究打合せ及び現地調査 Holding the 1 st International Workshop on Genetic Improvement of Cereals For Sustainable Production in Arid Lands in the ARC, discussion of the collaborative research and filed survey	日本学術振興会 JSPS
藤巻 晴行 Fujimaki, Haruyuki	ヨルダン Jordan	May 7- 13, 2015	限界地プロジェクトに係る研究調査 Research activities under the Project Marginal Region Agriculture	限界地プロジェクト Project Marginal Region Agriculture
	パレスチナ Palestine	Sep. 3-10, 2015	JSPS 二国間交流事業共同研究に係る研究調査 Research activities under a JSPS bilateral collaborative research scheme	日本学術振興会 JSPS
	トルコ Turkey	Oct. 10- 19, 2015	UNCCD COP12 の展示、サイドイベント及びテクニカルツアー参加 Participation in the exhibitions, side events and a technical tour of UNCCD COP12	運営費交付金 Cooperative Research Program of ALRC
	パレスチナ Palestine	Nov. 13- 14, 2015	限界地プロジェクトに係る研究調査 Research activities under the Project Marginal Region Agriculture	限界地プロジェクト Project Marginal Region Agriculture
	ヨルダン Jordan	Nov. 15- 19, 2015	限界地プロジェクトに係る研究調査 Research activities under the Project Marginal Region Agriculture	限界地プロジェクト Project Marginal Region Agriculture
	パレスチナ Palestine	Dec. 11- 13, 2015	「現地砂礫を活用した環境調和＋節水型の畑地かんがい法の展開」に係る研究調査 Research activities on “environmentally harmonious and water-saving upland irrigation utilizing gravels available in the field”	科学研究費補助金 JSPS Grant-in-Aid for Scientific Research (KAKENHI)
	ヨルダン Jordan	Dec. 14- 20, 2015	「現地砂礫を活用した環境調和＋節水型の畑地かんがい法の展開」に係る研究調査 Research activities on “environmentally harmonious and water-saving upland irrigation utilizing gravels available in the field”	科学研究費補助金 KAKENHI
	パレスチナ Palestine	Jan. 17- 22, 2016	JSPS 二国間交流事業共同研究に係る研究調査 Research activities under a JSPS bilateral collaborative research scheme	日本学術振興会 JSPS
	パレスチナ Palestine	Feb. 12- 17, 2016	JSPS 二国間交流事業共同研究に係る研究調査 Research activities under a JSPS bilateral collaborative research scheme	日本学術振興会 JSPS
	ヨルダン Jordan	Feb.29- Mar. 3, 2016	限界地プロジェクトに係る灌漑実験 Irrigation experiments under the Project Marginal Region Agriculture	限界地プロジェクト Project Marginal Region Agriculture
	パレスチナ Palestine	Mar.4, 2016	限界地プロジェクトに係る灌漑実験 Irrigation experiments under the Project Marginal Region Agriculture	限界地プロジェクト Project Marginal Region Agriculture
	ヨルダン Jordan	Mar.5-7, 2016	限界地プロジェクトに係る灌漑実験及び JICA ワークショップでの講演 Irrigation experiments under the Project Marginal Region Agriculture and a speech at JICA’s workshop	限界地プロジェクト Project Marginal Region Agriculture
パレスチナ Palestine	Mar.19- 26, 2016	JSPS 二国間交流事業共同研究に係る研究調査 Research activities under JSPS bilateral collaborative research scheme	日本学術振興会 JSPS	

氏名 Name	国名 Country	期間 Period	用務内容 Purpose	経費 Fund
山中 典和 Yamanaka, Norikazu	スーダン Sudan	May 20– Jun. 2, 2015	塩生植物を用いた環境修復に関する研究 Research on Phytoremediation of salt affected soils using woody halophytes	鳥取大学国際乾燥地研究 教育機構 IPDRE of TU
	中国 China	Jun. 22– Jul. 1, 2015	JSPS 二国間交流事業に係る打合せ及び調査 Meeting and field survey under a JSPS' Japan-China bilateral program	日本学術振興会 JSPS
	中国 China	Jul. 26– Aug. 1, 2015	内蒙古自治区フルンボイルにおける現地調査 Field survey of Japan-China-Korea DSS WG II in Hulun Boir, Inner Mongolia	海外環境協力センター Overseas Environmental Cooperation Center
	モンゴル Mongolia	Aug. 5– 14, 2015	黄砂発生地域における草原生態系の菌根共生と グロマリン蓄積に係る調査 Research on the Glomalin accumulation and arbuscular mycorrhizal symbiosis of grassland ecosystem in dust source areas	科学研究費補助金 KAKENHI
	中国 China	Aug. 22– Sep. 1, 2015	内蒙古自治区クブチ砂漠で行っている植林実験 の調査 Research on the Project Asian Dust and field survey in Kubuqi desert, Chna	黄砂プロジェクト Project Asian Dust
	韓国 South Korea	Dec. 1–4, 2015	日中韓三カ国黄砂共同研究ワーキング 2 会合へ の参加 Attendance at the meeting of Japan-China-Korea DSS WG II	海外環境協力センター Overseas Environmental Cooperation Center
谷口 武士 Taniguchi, Takeshi	スーダン Sudan	May 20– Jun. 2, 2015	塩生植物を用いた環境修復に関する研究 Research on environmental restoration using halophytes	鳥取大学国際乾燥地研究 教育機構 IPDRE of TU
	モンゴル Mongolia	Aug. 5– 14, 2015	黄砂発生域における草原生態系の菌根共生とグ ロマリン蓄積に係る現地調査 Field survey on mycorrhizal symbiosis and glomalin accumulation in grassland ecosystems in Asian dust source region	科学研究費補助金 KAKENHI
	中国 China	Aug. 22– Sep. 5, 2015	内蒙古自治区クブチ砂漠で行っている植林実験 の打合せ及び調査とサンプル処理 Meeting, research, and sample treatment for revegetation experiment in Kubuqi desert, Innder Mongolia	黄砂プロジェクト Project Asian Dust
	中国 China	Sep. 21– 29, 2015	黄砂発生源に係る調査と共同研究に係る打合せ Field survey in Asian dust source region and meeting for collaborative research	黄砂プロジェクト Project Asian Dust
	スーダン Sudan	Oct. 17– Nov. 11, 2015	限界地プロジェクト推進のための調査及び研究 打合せ Field survey and meeting for promotion of Project Marginal Region Agriculture	限界地プロジェクト Project Marginal Region Agriculture
伊藤 健彦 Ito, Takehiko	モンゴル Mongolia	Jul. 31– Aug. 9, 2015	馬乳酒生産研究に係る現地調査及び打合せ Field survey and meeting for collaborative research on <i>airag</i> production	明治大学 Meiji University
	モンゴル Mongolia	Aug. 10– 21, 2015	モンゴルの野生動物保全研究に係る現地調査及 び研究打合せ Field survey and meeting for collaborative research on wildlife conservation in Mongolia	科学研究費補助金 KAKENHI
	モンゴル Mongolia	Sep. 24– Oct. 6, 2015	モンゴルの野生動物保全に係る現地調査及び研 究打合せ Field survey and meeting for collaborative research on wildlife conservation in Mongolia	科学研究費補助金 KAKENHI

氏名 Name	国名 Country	期間 Period	用務内容 Purpose	経費 Fund
伊藤 健彦 Ito, Takehiko	オーストラリア Australia	Mar. 3–13, 2015	共同研究打合せ及び視察 Meeting for collaborative research and on-site inspection	鳥取大学国際乾燥地研究教育機構 IPDRE of TU
小林 伸行 Kobayashi, Nobuyuki	中国 China	May 3–31, 2015	蘭州大学との共同研究に係る現地調査及び準備作業 Preparatory activities and surveys for the collaborative research with Lanzhou University	限界地プロジェクト Project Marginal Region Agriculture
	中国 China	Jun. 26–Jul. 12, 2015	蘭州大学との共同研究に係る準備作業 Preparatory activities for the collaborative research with Lanzhou University	限界地プロジェクト Project Marginal Region Agriculture
	中国 China	Jul. 29–Aug. 8, 2015	蘭州大学との共同研究に係る試験の実施 Experimental works as the collaborative research with Lanzhou University	黄砂プロジェクト Project Asian Dust
	フィリピン Philippines	Aug. 17–22, Sep. 27–Oct. 4, 2015	国際乾燥地研究教育機構「人間開発と教育」グループにおける活動計画策定に係る現地調査 Preparatory survey for planning actions of ‘Education for Human Development Group’ of IPDRE	鳥取大学国際乾燥地研究教育機構 IPDRE of TU
	中国 China	Aug. 23–Sep. 26, 2015	蘭州大学との共同研究に係る試験の実施 Experimental works as the collaborative research with Lanzhou University	限界地プロジェクト Project Marginal Region Agriculture
	中国 China	Oct. 10–Nov. 21, 2015	蘭州大学との共同研究に係る試験の実施及び西北農林科技大学における国際学会への参加 Experimental works as the collaborative research with Lanzhou University and attendance for the international conference in Northwest Agriculture & Forestry University	私費 Private fund
	中国 China	Mar. 6–12, 2016	蘭州大学との共同研究に係る次年度準備作業 Preparatory activities for the collaborative research with Lanzhou University 2016	限界地プロジェクト Project Marginal Region Agriculture
	フィリピン Philippines	Mar. 20–23, 2016	国際乾燥地研究教育機構「人間開発と教育」グループにおける活動計画策定に係る現地調査 Preparatory survey for planning the actions of ‘Education for Human Development Group’ of IPDRE	鳥取大学国際乾燥地研究教育機構 IPDRE of TU
	北村 義信 Kitamura, Yoshinobu	パレスチナ Palestine	Jun. 8–13, 2015	JSPS 二国間交流事業共同研究に係る研究調査 Research activities under a JSPS bilateral collaborative research scheme
ヨルダン Jordan		Dec. 13–23, 2015	国際農林水産業研究推進「ヨルダンの農業、灌漑、水資源管理に関する情報・研究動向の調査」 Survey of research trends on agriculture, irrigation and water resources management in Jordan	国際農林水産業研究センター JIRCAS
ウズベキスタン Uzbekistan		Mar. 21–26, 2016	JIRCAS 塩害調査ワークショップへの出席、地下水調査結果等の現地確認 Field survey and attendance at Workshop 2015 JIRCAS Research on Measures against Salinization	国際農林水産業研究センター JIRCAS
Ubi, Benjamin Ewa	ナイジェリア Nigeria	Aug. 22–Sep. 1, 2015	国際学会参加 Attendance at an international conference of the Biotechnology Society of Nigeria	運営費交付金 Cooperative Research Program of ALRC
Mohamed Ahmed Ali, Isam Ali	スーダン Sudan	May 20–Jun. 2, 2015	塩生植物を用いた環境修復に関する研究 Research on Phytoremediation of salt affected soils using woody halophytes	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
王 新平 Wang, Xinping	アメリカ 合衆国 USA	Mar. 4– 25, 2016	研究打合せ Research meeting	運営費交付金 Cooperative Research Program of ALRC
	中国 China	Mar. 26– 31, 2016	中国科学院における資料収集 Data collection at the Chinese Academy of Sciences	運営費交付金 Cooperative Research Program of ALRC
Abdalla Ali, Mubarak Abdelrahman	スーダン Sudan	Dec. 23, 2015– Jan. 15, 2016	ハルツーム大学との共同研究に係る研究活動、サンプル採取及びセミナー出席 Activities concerning collaborative research between ALRC and the University of Khartoum, sample collection and attendance at the local seminar	運営費交付金 Cooperative Research Program of ALRC
留森 寿士 Tomemori, Hisashi	インド India	Jul. 7–11, 2015	限界地プロジェクトに係る研究打合せ及びICRISAT 施設視察 Meeting and inspections of ICRISAT facilities under the Project Marginal Region Agriculture	限界地プロジェクト Project Marginal Region Agriculture
	メキシコ Mexico	Jan. 27– Feb. 7, 2016	共同研究打合せ、試験場見学及びジャトロファ調査 Meeting for collaborative research, inspection of experiment stations and research on <i>Jatropha</i>	限界地プロジェクト Project Marginal Region Agriculture
Bat-Oyun, Tserenpurev	モンゴル Mongolia	Apr. 24– May 12, 2015	モンゴルの伝統食「馬乳酒」製造に係る伝統的知識の科学的検証と応用に関する調査 Field survey and research on traditional and scientific knowledge of <i>airag</i> (fermented horse milk) production in Mongolia	科学研究費補助金 KAKENHI
	モンゴル Mongolia	Jul. 30– Sep. 10, 2015	馬乳酒に係る調査及び研究打合せ Field survey and research meeting on <i>airag</i> (fermented horse milk) production	科学研究費補助金 KAKENHI
杉本 太郎 Sugimoto, Taro	モンゴル Mongolia	Aug. 12– Sep. 4, 2015	モンゴル西部ボブト周辺での野生動物の糞試料採取 Collecting fecal samples in the western Mongolia	科学研究費補助金 KAKENHI
	モンゴル Mongolia	Dec. 5– 24, 2015	モンゴル西部ボブト周辺での野生動物の糞試料採取及び研究打合せ Collecting fecal samples and research meeting in the western Mongolia	科学研究費補助金 KAKENHI
石川 智 Ishikawa, Satoshi	モンゴル Mongolia	Aug. 7– 27, 2015	黄砂発生源と考えられるモンゴル乾燥地に分布する湖沼の地形及び土壌調査 Geological survey on Mongolian arid area, which might have caused dust emissions	黄砂プロジェクト Project Asian Dust
Mohammed, Yasir Serag Alnor	スーダン Sudan	May 18– 29, 2015	共同研究打合せ Meeting for collaborative research	限界地プロジェクト Project Marginal Region Agriculture
	スーダン Sudan	Nov. 19– Dec. 4, 2015	コムギの播種及び研究打合せ Wheat seeding and meeting for collaborative research	限界地プロジェクト Project Marginal Region Agriculture
	スーダン Sudan	Feb. 14– 21, 2016	国際ワークショップにおける共同研究打合せ及び現地調査 Holding the 1 st International Workshop on Genetic Improvement of Cereals For Sustainable Production in Arid Lands in the ARC, discussion of the collaborative research and field survey	科学研究費補助金 KAKENHI

氏名 Name	国名 Country	期間 Period	用務内容 Purpose	経費 Fund
金 俊植 Kim, June-Sik	スーダン Sudan	Feb. 14– 21, 2016	国際ワークショップにおける共同研究打合せ及び現地調査 Holding the 1 st International Workshop on Genetic Improvement of Cereals For Sustainable Production in Arid Lands in the ARC, discussion of the collaborative research and filed survey	限界地プロジェクト Project Marginal Region Agriculture
坂口 巖 Sakaguchi, Iwao	パレスチナ Palestine	Nov. 13– 14, 2015	限界地プロジェクトに係る研究調査 Research activities under the Project Marginal Region Agriculture	限界地プロジェクト Project Marginal Region Agriculture
	ヨルダン Jordan	Nov. 15– 19, 2015	限界地プロジェクトに係る研究調査 Research activities under the Project Marginal Region Agriculture	限界地プロジェクト Project Marginal Region Agriculture
	ヨルダン Jordan	Feb. 29– Jul. 1, 2016	限界地プロジェクトに係る灌漑実験 Irrigation experiments under the Project Marginal Region Agriculture	限界地プロジェクト Project Marginal Region Agriculture

(4) 研究者・受託研究員・研究生の受入れ 研究者

Nasrein Mohamed Kamal Omer

(平成 27 年 5 月 1 日～平成 28 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

Mohammad Ulla

(平成 27 年 6 月 30 日～平成 27 年 10 月 31 日)
バングラデシュ核農業研究・研究員
国際原子力機構経費

Shigdaf Mekuriaw Zewdu

(平成 27 年 5 月 1 日～平成 27 年 9 月 25 日)
アムハラ地域農業研究所・アンダサ家畜研究センター・セ
ンター長
ユネスコ小淵恵三研究奨学金

張 宝林

(平成 27 年 12 月 25～平成 28 年 2 月 28 日)
内モンゴル師範大学・准教授
鳥取大学乾燥地研究センター経費

艾力江 麦麦提

(平成 27 年 11 月 23～平成 28 年 2 月 20 日)
新疆農業大学・講師
日本学生支援機構経費

受託研究員

2015JICA 課題別研修「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 27 年 8 月 17 日)
Shahsawari Parwiz (アフガニスタン)、Ouedraogo Sibde
Wendin Nestor (ブルキナファソ)、Pabgo Issa (ブルキナフ
アソ)、Aziz, Barzan Kamalaldeen Aziz (イラク)、Fahmi Salih
Sulaiman (イラク)、Abdou, Ibrahim (ニジェール)、Sanouna,
Boureima (ニジェール)、Nassar Mohammad Ibrahim Adnan
(パレスチナ)、ISSE Mohamud Mohamed (ソマリア)、
Yagoub, Alhadi Fadul Abdallah (スーダン)

研究生

Abd El. Baki Hassan Mohamed Fahmy

(平成 27 年 4 月 1 日～平成 27 年 9 月 30 日) エジプト

Sayed Mohamad Mahdavi Ababdansari

(平成 27 年 4 月 1 日～平成 27 年 11 月 30 日) イラン

邵揚 Shao Yang

(平成 27 年 10 月 1 日～平成 28 年 3 月 31 日) 中国

Itam Michael Okoi

(平成 27 年 10 月 1 日～平成 28 年 9 月 30 日) ナイジェ
リア

Yusra Ibrahim Osman Abdugader

(平成 27 年 10 月 1 日～平成 28 年 9 月 30 日) スーダン

(4) Visiting Researchers, Trainees and Research Students Visiting Researcher

Nasrein Mohamed Kamal Omer

(May 1 2015—Mar. 31 2015)
Researcher, Biotechnology and Biosafety Research Center,
Agriculture Research Corporation, Sudan
Private funds

Mohammad Ulla

(Jun. 30 2015—Oct. 31 2015)
Bangladesh Institute of Nuclear Agriculture (BINA)
Funded by the International Atomic Energy Agency (IAEA)

Shigdaf Mekuriaw Zewdu

(May 1 2015—Sep. 25 2015)
Associate Researcher, Andassa Livestock Research Center,
Amhara Region Agricultural Research Institute
UNESCO/ Keizo Obuchi Research Fellowships Programme

Baolin Zhang

(Dec. 25 2015—Feb. 28 2016)
Associate Professor, College of Chemistry and Environmental
Sciences, Inner Mongolia Normal University
Funded by Arid Land Research Center, Tottori University

Ailijiang Maimaiti

(Nov. 23 2015—Feb. 20 2016)
Postdoc. Researcher, Xinjiang Academy of Forestry
Funded by Japan Student Services Organization (JASSO)

Visiting Trainees

JICA Group Training Course 2015 “Appropriate Management of
Land and Water Resource for Sustainable Agriculture in
Arid/Semi-arid Regions”
Shahsawari Parwiz (Afghanistan), Ouedraogo Sibde Wendin
Nestor (Burkina Faso), Pabgo Issa (Burkina Faso), Aziz, Barzan
Kamalaldeen Aziz (Iraq), Kafroshi, Fahmi Salih Sulaiman (Iraq),
Abdou, Ibrahim (Niger), Sanouna, Boureima (Niger), Nassar
Mohammad Ibrahim Adnan (Palestinian), ISSE Mohamud
Mohamed (Somalia), Yagoub, Alhadi Fadul Abdallah (Sudan)

Research Students

Abd El. Baki Hassan Mohamed Fahmy

(Apr. 1 2015— Sep. 30 2015) Egypt

Sayed Mohamad Mahdavi Ababdansari

(Apr. 1 2015— Nov. 30 2015) Iran

Shao Yang

(Oct. 1 2015— Mar. 31 2016) China

Itam Michael Okoi

(Oct. 1 2015— Mar. 31 2016) Nigeria

Yusra Ibrahim Osman Abdugader

(Oct. 1 2015— Mar. 31 2016) Sudan