U.S. DEPARTMENT OF AGRICULTURE
Foreign Agricultural Service

NOTICE OF FUNDING OPPORTUNITY

2024 Norman E. Borlaug International Agricultural Science and Technology Fellowship Program

Application Submission Deadline: April 8, 2024

Summary

The U.S. Department of Agriculture, Foreign Agricultural Service, Fellowship Programs, announces this funding opportunity to support the Norman E. Borlaug International Agricultural Science and Technology Fellowship Program by issuing a new award(s). This opportunity is available to state cooperative institutions or other colleges and universities in the United States, as defined at 7 USC 3103 and is intended to place Fellows with U.S. research institutions for a 12-week intensive program. These programs are expected to contribute to the strategic goals and objectives of the Fellow and the institutions through a hands-on experience in a "real-world" agricultural research scenario, providing opportunity for application of research agendas where they can have a direct impact on food security and economic growth in an emerging economy.

A. Program Description

Background

Since 2004, the U.S. Congress has made funds available to the Borlaug Fellowship Program to advance USDA/FAS's agricultural research goals of promoting collaborative programs among agricultural professionals of eligible countries, agricultural professionals of the United States, the international agricultural research system, and United States entities conducting research by providing Fellowships to individuals from eligible countries who specialize or have experience in agricultural education, research, extension, or other related fields. Fellowships promote food security and economic growth in eligible countries by educating a new generation of agricultural scientists, increasing scientific knowledge and collaborative research to improve agricultural productivity, and extending that knowledge to users and intermediaries in the marketplace. The collaborative nature of the training and research programs not only benefits the Fellow, his or her home institution, and partner country; the U.S. host institution, its professors, researchers, and students; and the global agricultural sector by improving agricultural productivity, systems, and processes in partnering nations through the transfer of new science and agricultural technologies.

Objectives

USDA identifies Borlaug Fellows based on country-specific topics of importance to international agricultural trade. USDA then places Fellows with U.S. research institutions for 12-week intensive programs, where Fellows will study under the tutelage of a faculty Mentor at the matched U.S. research institution. This period will align with the 2024 Fall session of classes at the respective host university. Additionally, Fellows are expected to attend the 2024 World Food Prize; and therefore, awardees must budget for the event in their proposal submissions. The awardees must budget for travel, M&IE, and lodging for the Fellow and Mentor in and to Des Moines, Iowa. These programs are expected to contribute to the strategic goals and objectives of the Fellow and the institutions through a hands-on experience in an agricultural research

scenario, providing opportunity for application of research agendas where they can have a direct impact on food security and economic growth in an emerging economy. It is hoped that host institutions will share the knowledge gained through the program in their classroom and extension work with their faculty, students, extension officers, and constituents; and that they will continue to maintain professional contacts with the Fellows after their departure from the United States.

Scope of Work

The selected institutions will design and implement a training program to meet one or more of the Fellow's proposed research goals and objectives to the closest extent possible. The selected institution will also include leadership and communication training to help the Fellow better communicate research conducted under their Fellowship to policy makers in their respective countries to help implement science-based agricultural policies. The Fellows' proposed research and training objectives, and full descriptions are in the appendix which can be quickly accessed via the link in the table:

Fellow Specific Objectives:

Funding Opportunity Number
USDA-FAS-10777-0700-10.-24-0002

Assistance Listing Number
10.777 Norman E. Borlaug International Agricultural Science and Technology Fellowship

Authorizing Legislation
National Agricultural Research, Extension, and Teaching Policy Act of 1977, PL 95-113, as amended, 7 USC §§ 3291, 3319a

B. Federal Award Information

Total Available Federal Funding:	Up to $1,650,000 total; up to $75,000 per award *subject to the availability of funding*.
Anticipated Number of Awards:	up to 22
Cost Share/Match Requirement:	None/Not Required
Projected Period of Performance Start:	August 15, 2024
Projected Period of Performance End:	July 31, 2026

Type of Assistance Instrument:
USDA/FAS anticipates that Cost-Reimbursable Agreements will be funded pursuant to this funding opportunity.

This type of agreement allows for a collaborative relationship between USDA/FAS, the selected recipient, and other collaborating partners. The particular scope and depth of this collaboration may vary throughout performance, depending on the needs of the activity and the desires of the Fellows.

Additional Awards
USDA/FAS reserves the right to make additional awards under this solicitation, consistent with Agency policy and guidance, if additional funding becomes available after the original selections are made. Any additional selections for awards will be made no later than 6 months after the original selection decisions.

No Awards
USDA/FAS reserves the right to make no awards under this competition.

C. Eligibility Information

Eligible Applicants: State cooperative institutions or other colleges and universities in the United States, as defined at 7 USC 3103

All applicants must have an active registration in the U.S. Government System for Award Management (www.sam.gov) before the application submission deadline of the announcement; applicants with inactive, expired, pending, or excluded listings will be deemed ineligible. Exceptions, waivers, or extensions will not be considered. Please contact the program officer(s) listed in Section G, Federal Awarding Agency Contact, if you have questions about this requirement. Applicants with inactive, expired, pending, or excluded listings will be deemed ineligible. Exceptions, waivers, or extensions will not be considered. Please contact the program officer(s) listed in Section G, Federal Awarding Agency Contact, if you have questions about this requirement.

Cost Share/Match Requirement: None/Not Required

Ineligible activities: If an application is submitted that includes any ineligible tasks or activities, that portion of the application will be ineligible for funding and may, depending on the extent to which it affects the application, render the entire application ineligible for funding.

Application packages submitted on expired/inactive standard forms, could be deemed ineligible. Applicants must ensure they are utilizing the active/nonexpired forms available on grants.gov.

Substantial Compliance
All applications will be reviewed for eligibility and must meet the eligibility requirements described in Section C to be considered eligible. Applicants deemed ineligible for funding consideration as a result of the threshold eligibility review will be notified within seven calendar days of the ineligibility determination.

Applications must substantially comply with the application submission instructions and requirements set forth in Section D of this solicitation or else they will be rejected. However, where a page limit is expressed in Section D with respect to the application, or parts thereof, pages in excess of the page limitation will not be reviewed. Applicants are advised that readability is of paramount importance and should take precedence in application format, including selecting a legible font type and size for use in the application.

While these guidelines may establish the minimum type size requirements, applicants are advised that readability is of paramount importance and should take precedence in selection of an appropriate font for use in the application.

Evidence of Eligibility
Applicants are responsible for including documentation, if necessary, establishing that they meet the stated eligibility requirements, when it is not immediately obvious. Applicants should not presume that USDA/FAS is sufficiently familiar with their organization that this is unnecessary, and USDA/FAS will not make assumptions as to the nature of the applicant's organization.

D. Application and Submission Information

This announcement contains all information necessary to apply to this funding opportunity.

Deadline for Question Submission: March 19, 2024
Applicants may submit questions about this funding opportunity to the Section G contact.

Submission Dates and Times
Application Submission Deadline: April 8, 2024 at 11:59pm EDT (UTC -04:00)

Applications received after this time will not be accepted. Applicants are advised to make their submissions 1-2 days before this deadline in case of computer problems.

Anticipated Award Date: **May 6, 2024**

Content and Form of Application Submission
A complete application package must include:

- Standard Form SF-424, Application for Federal Assistance, showing the Unique Entity Identifier, and signed by the applicant.
- Standard Form SF-424A, Budget Information for Non-Construction Programs, showing the budget categorization. Applicants are advised to consult 2 CFR 200 Subpart E for guidance on proper categorization of cost items. An improper categorization will not itself be grounds for a determination of ineligibility but may delay approval and/or adversely impact the application's evaluation scoring.
- A detailed budget table and budget narrative, in which cost items are quantified and described in sufficient detail to enable USDA/FAS to independently determine that the proposed costs are reasonable and allowable for the project and consistent with applicable regulations.
    - Indirect costs are statutorily capped at 10% for cost reimbursable agreements.
    - The budget table will include Meals and Incidentals, Travel, Transportation and lodging as needed for the following activities:
        - Fellow's travel to and from home country,
        - Fellow's stay at host institution (GSA Rate),
        - Mentor's Pre-Fellowship visit,
        - Mentor and Fellow's USDA headquarters orientation,
        - Fellow's World Food Prize attendance,
        - Mentor and Fellow's Post-program USDA headquarters debrief,
        - Mentor's post-Fellowship visit.
        - Include best estimates for proposed Research supplies.
- A detailed project narrative or plan of operation:
    - Indicate the name of the institution applying to host the Fellow,

- Indicate the training topic and Fellow country/number as stated in the appendix,
- Provide a tentative 12-week training plan based on the training interests listed in the statement of work, including topics to be covered, possible field visits and other activities, with tentative dates,
- Provide a narrative description of the proposed training, how it will be administered and the role of the university faculty and support staff, and if applicable collaborating scientists,
- Include a narrative description of the proposed training including the following elements: orientations, classroom instruction, field demonstrations and/or field visits, leadership development, conference attendance, term break activities, and cultural opportunities,
- Include a narrative description of how the program will be administered and the expertise and roles of the university faculty, support staff, and collaborating scientists, including potential Mentors identified to participate,
- Provide a summary of relevant institutional capabilities for hosting international Fellows in the applicable topic(s), and a description of how regional and university resources would be used to enhance the program,
- Briefly describe the expertise and international experience of the applicant in the Fellow's field of interest, their respective countries, and how the overall program plan and design is relevant to the Fellow's objectives and background,
- Demonstrate understanding of cultural context and needs of the Fellows,
- Demonstrate how the proposal aligns with USDA/FAS's agricultural programs, policies, and development and extension goals and those of the Fellow's country,
- Identify the expected skills or knowledge to be acquired by the Fellows at the end of the program,
- Include information on the J-1 Visa compliant medical insurance coverage to be obtained for all Fellows and ensure it is comparable to NRIOL.net's J-1 Visa Health Insurance Coverage (https://www.nriol.net/j1-visa-health-insurance/)
- Demonstrate flexibility within the training plan to account for potential program changes and explain the applicant's ability to respond to unforeseen circumstances,
- Include a quality assurance plan, which should include information on how unforeseen problems that can arise will be addressed,
- Ensure the project narrative or plan of operation is organized, written in English, is free of excessive grammatical and spelling errors, contains any source information properly cited, and is submitted in PDF format,
    - Applicants are advised that readability is of paramount importance and should take precedence in application format, including selecting a legible font type and size for use in the application,

- Standard Form SF-LLL, Disclosure of Lobbying Activities, if applicable to the applicant

Unique Entity Identifier and System for Award Management (SAM)

Each applicant is required to:

(i) Have an active registration in SAM before submitting its application,
(ii) Have assented to the federal assistance certifications in the SAM platform,
(iii) Provide a valid Unique Entity Identifier (UEI) in its application; and

(iv) Continue to maintain an active SAM registration with current information at all times during which it has an active Federal award or an application or plan under consideration by a Federal awarding agency.

SAM.gov Registration Instructions
Organizations applying to this funding opportunity must have an active SAM.gov registration. If you have never done business with the Federal Government, you will need to register your organization in SAM.gov. If you do not have a SAM.gov account, then you will create an account using login.gov[1] to complete your SAM.gov registration. SAM.gov registration is FREE. The process for entity registrations includes obtaining Unique Entity ID (UEI), a 12-character alphanumeric ID assigned an entity by SAM.gov, and requires assertions, representations and certifications, and other information about your organization. Please review the Entity Registration Checklist for details on this process.

Entities outside the United States (defined at 2 CFR 200.1 as "foreign organizations" and "foreign public entities") must obtain a NATO Commercial and Government Entity (NCAGE) Code prior to SAM.gov registration An NCAGE is required for all foreign entities prior to registering in SAM.gov. You can complete the registration once you enter the NCAGE. You can submit your request for an NCAGE Code by going to the NATO Support Activity (NSPA) NCAGE Request Tool at CAGE/NCAGE Code Request which contains detailed instructions.

If you have done business with the Federal Government previously, you can check your entity status using your government issued UEI to determine if your registration is active. SAM.gov requires you renew your registration every 365 days to keep it active.

Please note that SAM.gov registration is different than obtaining a UEI only. Obtaining an UEI only validates your organization's legal business name and address. Please review the Frequently Asked Question on the difference for additional details.

Organizations should ensure that their SAM.gov registration includes a current e-Business (EBiz) point of contact name and email address. The EBiz point of contact is critical for Grants.gov Registration and system functionality.

Contact the Federal Service Desk for help with your SAM.gov account, to resolve technical issues or chat with a help desk agent: (866) 606-8220. The Federal Service desk hours of operation are Monday – Friday 8am – 8pm ET.

Intergovernmental Review
Executive Order 12372, Intergovernmental Review of Federal Programs, may be applicable to awards resulting from this announcement. USDA implemented the Executive Order in 2 CFR 415.5. USDA/FAS may require applicants selected for funding to provide a copy of their application to their State Point of Contact (SPOC) for review. These reviews are not required before submitting an application. Only applicants that USDA/FAS selects for funding under this announcement are subject to the Intergovernmental Review requirement. For more information

[1] Login.gov a secure sign in service used by the public to sign into Federal Agency systems including SAM.gov and Grants.gov. For help with login.gov accounts you should visit http://login.gov/help.

about USDA's implementation for Intergovernmental Review, please visit https://www.usda.gov/ocfo/federal-financial-assistance-policy/intergovernmental-review#:~:text=Executive%20Order%20(EO)%2012372%2C,of%20proposed%20Federal%20financial%20assistance.

Funding Restrictions
Generally, funds may not be used in any manner that is prohibited by applicable regulations, including 2 CFR Part 200 and 2 CFR Part 400. Awards issued pursuant to this notice of funding opportunity may only be used for the purpose set forth in the award, consistent with the statutory authority for the award. Capital expenses, such as the purchase of equipment, not entirely attributable to this award, must be pro-rated.

For example, agreement funds and other support may not be used for matching contributions for other federal grants or cooperative agreements, lobbying, or intervention in federal regulatory or adjudicatory proceedings. Federal employees are prohibited from acting as an agent of the applicant in any capacity (paid or unpaid) on any proposal submitted under this program. Also, federal funds may not be used to sue the Federal Government or any other government entity.

Compensation for personal services: Employees, consultants, or other personnel, including those of subrecipients, and regardless of the method of engagement, may not exceed the pro-rata equivalent of GS-15 on the General Schedule (for 2024, $159,950 per year, $612.84 per day, or $76.60 per hour) Non-monetizable fringe benefits, such as health insurance coverage, are not included to this ceiling.

Indirect Costs: In general, costs incurred for a common or joint purpose benefitting more than one cost objective but not readily assignable to specific awards, without effort disproportionate to the results achieved, are considered indirect costs. These may include facilities not specific to individual projects, enterprise-wide services such as IT, and enterprise management. For cost-reimbursable agreements, indirect costs may not exceed 10% of direct costs, as stipulated at 7 USC 3319a.

Other Submission Information
Applications should be submitted through the ezFedGrants system at https://grants.fms.usda.gov/

Applicants who require assistance with any USDA-managed computer system should reach out to the program officer(s) listed in Section G, Federal Awarding Agency Contact, at least 5 business days in advance of the application submission deadline. Applicants should provide as much detail as possible to facilitate resolution of the issue.

E. Application Review Information

Review and Selection Process
In all cases, the agency will conduct an initial responsiveness review of all applications submitted to determine:

1) the application was submitted on time as specified in this announcement (See Section D. Application and Submission Information),

2) the applicant is eligible (see Section C. Eligibility Information),
3) all the required forms and documents are submitted no later than the Application Submission Deadline specified in Section D. Application and Submission Information, Content and Form of Application Submission.

If an applicant is determined to be ineligible or an application is determined to be incomplete, the agency will notify the applicant prior to commencing with evaluation of applications, usually within seven business days of the Application Submission Deadline. An applicant that feels such a determination is made in error may request reconsideration, highlighting evidence supporting their claim, by email to the program officer(s) listed in Section G, Federal Awarding Agency Contact, within 3 business days of notification.

The agency will convene a review panel, which may include both federal and non-federal reviewers, to review the eligible applications against the evaluation criteria described below. The reviewers will ensure that the applicant is capable of delivering the programs/activities as described in the announcement based on the applicant's project narrative and assign a score and provide summary comments based on the evaluation criteria identified below. The review panel will make a recommendation list to the selecting official, who is not a member of the panel.

The selecting official may select applications out of rank order in consideration of strategic program priorities, such as geographical distribution, incorporation of minority-serving institutions, or congressional directive. Selection determinations are final and cannot be appealed.

Prior to selection, the agency may contact the highest-ranking applicants to seek clarification and to negotiate technical and programmatic aspects of the application. If an application includes a subaward, FAS may request to speak with all parties included in the application to ensure sufficient planning and coordination has taken place prior to making an award.

Evaluation Criteria
Applicants will be evaluated on the extent and quality to which they demonstrate that they have the capabilities, staff, resources, and equipment to successfully perform the project as described in the following factors. Scoring will also be based on the level of detail and how clearly the applicant's capacities to address these factors that are outlined in the proposal.

Factor 1: Technical Expertise and Experience (30 points)
The applicant will be evaluated on extent and quality to which they demonstrate how the program objectives will be achieved through their appropriate technical background, expertise and abilities and program plans including:

- Experience with international training and adult education defined and detailed (10 points)
    - Applicant's explanation of their experience with international training and adult-education (should experience be lacking, the applicant may not receive points for this section).
- Mentor and other support staff qualifications defined and detailed (20 points)

- Applicant's demonstration of their suggested Mentor's technical background and advanced training and how it can match the skills of the Borlaug Fellowship Program Fellow.
- Applicant's explanation of how other appropriate collaborating scientists might be identified to meet any of the objectives which the identified Mentor cannot address.

Factor 2: Overall Program (40 points)

The applicant will be evaluated on the extent and quality to which they demonstration that the overall program plan and design tis strategically aligned and relevant to the stated objectives including:

Program Design, Applicability and Alignment (20 Points)

- Applicant's explanation of their ability to align with the Fellow's scope of work.
- Applicant's explanation of their ability to align training topics with USDA/FAS's agricultural programs, policies, and development and extension goals and those of the Fellow's country.
- Applicant's demonstration of their experience and knowledge of relevant agricultural conditions within the Fellow's country or similar location.
- Applicant's demonstration of how the overall program plan and design is relevant to the Fellow's objectives and background.
- Applicant's explanations of their international expertise and ability to address and cultural considerations of the Fellow, including its ability to tailor the training and program implementation to the needs of the Fellow.
- Applicant's demonstration of how regional and university resources, including the presence of relevant agricultural practices in the region, would be used to enhance the program,

Program implementation plans and strategies included (20 Points)

- Applicant's explanation of the overall program plan, how the institution will be involved to ensure the desired pre-program, mid-program, and post-program deliverables will be achieved and the Fellow's stated goals and objectives met.
- Applicant's explanation of flexibility in training plan to account for potential program changes and the ability to respond to unforeseen circumstances,
- Applicant's explanation of the following strategies and plans showcasing their flexibility and ability to respond in the event of unforeseen circumstances:
  - Risk Mitigation and Response Plan
  - Quality Assurance Plan

Factor 3: Professional Detailed Budget and Budget Narrative (25 points)

The applicant will be evaluated on the reasonableness, cost-effectiveness, and adequacy of the proposed budget to accomplish the project, along with the extent to which the budget documents are detailed, organized, in-scope, and appropriate, including:

- Appropriate and detailed content included (15 Points)
  - Applicant's demonstration that the proposed budget is appropriate for the activities and requirements for the Fellow's program, including Meals and Incidentals, Travel, Transportation and lodging as needed for the following activities:

        - Fellow's travel to and from home country,
        - Fellow's stay at host institution (GSA Rate),
        - Mentor's Pre-Fellowship visit,
        - Mentor and Fellow's USDA headquarters orientation,
        - Fellow's World Food Prize attendance,
        - Mentor and Fellow's Post-program USDA headquarters debrief,
        - Mentor's post-Fellowship visit.
        - Include best estimates for proposed Research supplies.
    - Applicant's use of a detailed budget table that utilizes cost item categories and includes appropriate cost savings where available.
    - Applicant's explanation of proposed staff, including their role in the program.
- Budget narrative and budget table included (10 Points)
    - Applicant's use of a clear budget narrative accompanying the budget table to address each line item therein.
    - Applicant's demonstration of successful rounding and calculating with final budget narrative numbers exactly matching the budget line items, rounded to the penny.

Factor 4: Professional Formatting, Spelling, and Grammar (5 Points)

The applicant will be evaluated on the extent to which their budget and proposal documents are detailed, organized, in-scope, and appropriate including:

- Professional formatting, spelling, and grammar utilized (5 Points)
    - Applicant's demonstration of professional organization and formatting throughout the project narrative and supporting documents with limited spelling and grammatical errors.

Integrity in Performance

Prior to making a Federal award, the Federal awarding agency is required by 31 USC 3321 and 41 USC 2313 to review information available through any OMB-designated repositories of government-wide eligibility qualification or financial integrity information. Therefore, application evaluation criteria may include the following risk-based considerations of the applicant: (1) financial stability; (2) quality of management systems and ability to meet management standards; (3) history of performance in managing federal award; (4) reports and findings from audits; and (5) ability to effectively implement statutory, regulatory, or other requirements.

Conflict of Interest

The Applicant's Conflict of Interest (COI) Point of Contact as defined in USDA/FAS Conflict of Interest Policy must notify the USDA/FAS contact identified in Section G of this solicitation of any actual or potential conflict of interest that they are aware of that may provide the Applicant with an unfair competitive advantage in competing for USDA/FAS financial assistance awards within 10 calendar days of becoming aware of the conflict of interest. Examples of an unfair competitive advantage include but are not limited to situations in which an USDA/FAS employee reviewed and commented on or drafted all or part of an applicant's application. Note that USDA/FAS does not generally consider receiving information from an USDA/FAS employee limited to whether the applicant or the applicant's proposed project is eligible to

compete for funding to confer an unfair competitive advantage. In addition, assistance agreements made under this solicitation will include a term and condition notifying recipients of their COI disclosure obligations and responsibilities under the award including the need to have systems in place to address, resolve and disclose COIs to USDA/FAS.

F. Federal Award Administration Information

Federal Award Notices

Successful applicants will be notified of the status of their application/award by email. This notification is not authorization to proceed, and such notification should be construed as provisional.

Administrative and National Policy Requirements

All successful applicants for all grant and cooperative agreements are required to comply with the applicable General Administrative Terms and Conditions, which can be found at https://www.fas.usda.gov/grants/general_terms_and_conditions/default.asp. The applicant is presumed to have read, understood, and accepted these terms when accepting a USDA/FAS award. Applicants with questions about the applicable terms should contact the program officer(s) listed in Section G, Federal Awarding Agency Contact.

The applicable Terms and Conditions will be for the last year specified at that URL.

Before accepting an award, the applicant should carefully read the award package for instructions on administering the award and the terms and conditions associated with responsibilities under Federal Awards. Applicants must accept all conditions in this NOFO as well as any Special Terms and Conditions in the Notice of Award to receive an award under this program.

Subaward and Executive Compensation Reporting

Applicants must ensure that they have the necessary processes and systems in place to comply with the subaward and executive total compensation reporting requirements established at 2 CFR 170, unless they quality for an exception from the requirements, should they be selected for funding.

Mandatory Disclosures

As required by 2 CFR 200.113, non-federal entities or applicants for a Federal award must disclose, in a timely manner, in writing to the Federal awarding agency or pass-through entity all violations of Federal criminal law involving fraud, bribery, or gratuity violations potentially affecting the Federal award. Failure to make required disclosures can result in any of the remedies described in 2 CFR 200.339 including suspension and debarment.

Performance Expectations

(1) Assignment of a Principal Investigator (Training Coordinator)

The host institution should designate a contact person as the Principal Investigator (PI) responsible for coordinating all administrative and programmatic arrangements.

(2) Assignment of a Mentor

A key component of the program is matching the Fellow with a Mentor. The host institution will select an appropriate Mentor for one-on-one work with the Fellow for the duration of the program.

- A single Mentor may not host two Fellows simultaneously. Both the Principal Investigator (PI) and the Mentor must hold a position at an eligible U.S. institution.
- The Mentor will establish a professional relationship providing guidance and training in the Fellow's research and studies.
- The Mentor will work with the Fellow before arrival to discuss appropriate work plan, site visits, and other arrangements;
- The Mentor will provide the agreed upon work plan through the PI to USDA/FAS for consultation and approval approximately 2 weeks before the commencement of the program;
- The Mentor agrees to commit a significant amount of time each week for one-on-one work with the Fellow during the program;
- The Mentor will commit to visit the Fellow's country prior to Fellow's arrival in the United States;
- The Mentor will continue communicating with the Fellow beyond the end of the program in the U.S. through the mentor visit;
- The Mentor will submit semi-annual progress reports that indicate all program activities are conducted;
- The Mentor may assign other faculty members to assist with Fellow's training and research activities;
- The Mentor may not be assigned to multiple Fellows during the same time frame.
- The Mentor should include a leadership component to the training curricula; training course, workshop, or other suitable activity that provides leadership training to the Fellow;

(3) Mentor Pre-Fellowship Visit

- The Mentor pre-Fellowship visit is a required component of the Borlaug Fellowship Program.
- The Mentor will work with the Fellow to plan a pre-Fellowship visit to the Fellow's home country. The trip should occur before the program begins.
- The Mentor will evaluate the Fellow's work environment, capabilities, and establish a relationship to ensure research alignment and a productive early program.
- The PI will provide USDA/FAS with an agenda for Mentor's pre-Fellowship visit, including goals and objectives, three weeks prior to the trip. The Mentor's travel information must be provided for emergency contact purposes and country clearance (if required by the cognizant FAS Overseas Office).
- The Mentor will provide a trip report highlighting the trip's activities and results through the PI to USDA/FAS within 30 days after the visit.
- The Mentor should plan to meet with the USDA/FAS Attaché or staff from the U.S. Embassy while they are traveling, if feasible. USDA/FAS can assist with coordination prior to the trip.

- The Institution is expected to provide the Mentor airfare to and from the Fellow's home country, travel and hotel expenses, and M&IE while in the Fellow's home country.

(4) Travel and Transportation

- The host institution must comply with the Federal Travel Regulations (41 CFR 300 et seq.).
- The host institution will budget for economy class, international airfare from the Fellow's home to Washington, D.C., and to the university.
- The host institution will budget for economy class, international airfare from the university to Washington, D.C., and on to the Fellow's home country after the USDA debrief visit.
- The host institution will budget for economy class, domestic airfare for the Mentor accompanying the Fellow to the Washington, D.C., USDA visits.
- The host institution is responsible for arranging and purchasing all domestic travel related to the Fellow's training program, this includes transportation to and from Des Moines, Iowa for the World Food Prize.
- The host institution will provide housing for the Fellow for the duration of the training program, taking into account gender and cultural norms.
- The host institution will pay lodging fees directly. The host institution will not require the Fellow to pay for his or her lodging expenses, whether through reimbursement or advance payment.
- Lodging will include a private bedroom, private or shared bathroom, access to a laundry room, and access to a kitchen with pots, pans, and utensils.
- Necessities, such as sheets, towels, and cleaning supplies, will be provided for Fellow's use. The Fellow should not have to pay for these items.
- Lodging will be within walking distance to the campus/training location or easily accessible by public transportation.
- If public transportation is required to access campus/training location, the host institution will provide the Fellow with a bus pass or proper allowance for transportation expenses.
- When planning lodging options, the host institution should check with the Fellow and account for any special dietary restrictions or preferences, or accessibility needs.

(5) Meals and Incidentals (M&IE)

- The host institution will provide each Fellow with meal and living allowances for the duration of stay.
- Daily M&IE allowance may not exceed current GSA per diem rates.
- The host institution can determine the frequency of per diem allotments, but the Fellow must receive per diem within the first week of the program. The PI must inform the Fellow and USDA/FAS immediately if this cannot be accommodated.

(6) **Emergency Health Insurance**

- The Fellow will not be required to purchase his or her health insurance and then be reimbursed.
- USDA FAS will provide fellows with:
  - J-1 Complaint Emergency Medical Insurance.
  - DS-2019/J-1 visa support for Fellows and related SEVIS requirements
- The host institution will educate the Fellow as to what is covered under health insurance policy, especially highlighting that pre-existing medical conditions are not covered.
- The host institution will immediately alert USDA/FAS staff if any health/medical conditions arise during the program.

(7) Communication

- The host institution will initiate contact with the Fellow as soon as possible.
- The host institution will develop the training program in consultation with USDA/FAS and the Fellow.
- The host institution will keep USDA/FAS informed regarding any logistical or program planning.
- The host institution will notify USDA/FAS immediately upon Fellow's physical arrival and departure from the U.S. to comply with U.S. Department of Homeland Security requirements.
- The host institution will provide USDA/FAS with the Fellow's temporary U.S. address and phone number, and emergency contact numbers for the PI, Mentor, or other appropriate institution personnel. This information is required so that Fellow can be reached in the event of an emergency.

(8) Program

- The host institution will provide educational materials and supplies to each Fellow necessary for their full participation in the program.
- The host institution will pay for all fees related to the Fellow's training program, such as (but not limited to) technology fees, administrative fees, laboratory fees, etc.
- The host institution will arrange relevant field visits as applicable to the Fellow's training program.
- The host institution will ensure the submission of semi-annual performance and financial reports as well as final performance and financial reports to USDA/FAS every six months and after the completion of the program respectively. Reports should include the following:
  - Summary of activities, accomplishments, and any problems encountered or overcome
  - Photographs, when possible
- The Mentor ensures that the Fellow completes the Post-Program Evaluation.

(9) Orientation

- The PI/Training Coordinator will communicate directly with the Fellow at least 4-8 weeks before his or her arrival in the U.S. to ensure that all pertinent information is provided, including:

- Name and contact information of PI/Training Coordinator
- Name and contact information of Mentor
- Institution information, weather information, and clothing needs
- Housing and M&IE allowance
- Program plan and anticipated site visits
- Professional development expectations
- Reminder to bring any necessary prescription medications
- Explain what is and is not covered under emergency health insurance policy (e.g. no pre-existing conditions, no dental, etc.)

- Institution will provide an orientation upon the Fellow's arrival to acquaint them with campus and community resources, such as:
  - Explanation and demonstration of local bus/transportation options
  - Explanation of cultural and legal expectations
- USDA will provide a welcome and orientation packet for Fellows upon arrival.

(10) Mentor Follow-up Visit

- The Mentor visit is a required component of the Borlaug Fellowship Program.
- The Mentor will work with the Fellow to plan a follow-up visit to the Fellow's home country. The trip must occur within 6 months to 1 year after the program ends and no sooner than 3 months before the end of the agreement.
- The Mentor will follow up with the Fellow for an additional year after their visit to assess the impact of the exchange program.
- The PI will provide USDA/FAS with an agenda for Mentor's reciprocal visit, including goals and objectives, three weeks prior to the trip. The Mentor's travel information must be provided for emergency contact purposes and country clearance (if required by the cognizant FAS Overseas Office).
- The Mentor will provide a trip report highlighting the trip's activities and results through the PI to USDA/FAS within 30 days after the visit.
- The Mentor should plan to meet with the USDA/FAS Attaché or staff from the U.S. Embassy while they are traveling, if feasible. USDA/FAS can assist with coordination prior to the trip.

(11) USDA/FAS Headquarters Orientation and Debrief (DC Visits)

- The Fellow's USDA/FAS- Washington D.C. orientation and debriefs are a required component of the Borlaug Fellowship Program.
- Institution will include a budgeted amount for a visit to USDA/FAS headquarters in Washington D.C. upon the Fellow's arrival to and departure from the United States.
- The Fellow's USDA/FAS orientation and debrief will last one day and they will be hosted by USDA/FAS at their headquarters in Washington D.C.
- The Institution will send at least one representative to the USDA/FAS Headquarters orientation and debrief to welcome the Fellow. Mentors are highly encouraged to represent the Institution at the USDA/FAS headquarters orientation and debrief.
- The Institution is expected to provide the following for the Fellow's orientation and debrief:

- Flights from the Fellow's Country to and from Washington D.C.
- Flights from Washington D.C. to the Fellow's Fellowship location
- Hotel and M&IE while in Washington D.C.
- Transportation around the D.C. Metro Area, including transportation to and from the airport.

- USDA/FAS will provide an agenda, and speakers for the Fellow's USDA orientation and debrief.

(12) 2024 Fall Fellow and Mentor's World Food Prize Attendance

- World Food Prize participation is a requirement for the Borlaug Fellowship Program for Fellows and Mentors.
- The Institution will budget for the Fellow and Mentor's transportation to and from Des Moines, Iowa.
- The Institution will budget for lodging allowance and M&IE for the Fellow and Mentor's time in Des Moines (at the Federal Government rates).
- USDA will provide an agenda and programming for the Fellow and Mentor's time in Des Moines.

Reporting

Financial Reports, using form SF-425, Federal Financial Report (FFR), must be submitted semi-annually, within 30 days of the end of the reporting period. A final financial report must be submitted within 120 days of the end date of the agreement.

Performance Progress Reports must be submitted semi-annually, within 30 days of the end of the reporting period. A final performance progress report must be submitted within 120 days of the end date of the agreement. The recipient may use any appropriate format for performance progress reports, provided the report includes:

a) A comparison of actual accomplishments to those projected for the period;
b) The reasons why established goals were not met, if appropriate; and
c) Additional pertinent information including, when appropriate, analysis and explanation of cost overruns or high unit costs.

Recipients are encouraged to include photographs and other supplemental material in performance progress reports. For awards in which the total lifetime value exceeds $500,000, additional reporting may be required as described in Appendix XII to 2 CFR 200.

Monitoring

USDA/FAS through its authorized representatives, has the right, at all reasonable times, to make site visits to review project accomplishments and management control systems and to provide such technical assistance as may be required. During site visits, USDA/FAS will review recipients' files related to the program.

As part of any monitoring and program evaluation activities, grant recipients must permit USDA/FAS, upon reasonable notice, to review assistance agreement-related records and to interview the organization's staff and clients regarding the program, and to respond in a timely and accurate manner to FAS requests for information relating to the program.

Closeout
Within 120 days after the end of the period of performance, recipients must submit a final FFR and final progress report detailing all accomplishments and a qualitative summary of the impact of those accomplishments throughout the period of performance. After final reports have been reviewed and approved by the agency, and any residual amount due to the recipient or due to be returned to the agency, the award is subject to closeout. Acceptance of final reports by the agency constitutes a closeout of the award with no further notice or obligation to either party. This acceptance will indicate the period of performance has expired, and any remaining funds will be de-obligated. Records must be retained for a minimum of three years after the final reports are submitted.

G. Federal Awarding Agency Contact

For all inquiries, contact:

Name: Joyce West, Karen Uetrecht, or Tanya Hinnant
Email Address: Joyce.West@usda.gov, Karen.Uetrecht@usda.gov, or Tanya.Hinnant@usda.gov
Hours of Operation: Monday - Friday: 8:00 AM – 4:30 PM Eastern Standard Time

H. Other Information

Budget Revisions
Transfers of funds between direct cost categories in the approved budget when such cumulative transfers among those direct cost categories exceed ten percent of the total budget approved in this Award require written approval from the agency. The total budget amount may not be increased without a bilaterally executed amendment to the award.

Post-Award Program Income
In the event program income becomes available to the recipient post-award, it is the recipient's responsibility to notify the USDA/FAS Program Manager to explain how that development occurred, as part of their request for guidance and/or approval. If approval is granted, an award modification will be issued with an explanatory note in the remarks section of the face page concerning guidance and/or options pertaining to the recipient's approved request. All instances of program income shall be listed in the progress and financial reports.

Electronic Signatures
Consistent with the Electronic Signatures in Global and National Commerce Act (ESIGN Act), USDA/FAS uses and accepts electronic signatures for application and award documents. USDA/FAS will neither solicit nor send physical copies of documents.

Appendix:

Borlaug Fellowship Program – Algeria – Water management and Desalinization – Fellow #1

Scope of Work
Fellow #1: Algeria, Male, Senior Researcher, National Institute for Agronomic Research, PhD, Agri-Water Management

Goal
Sustainability of agricultural systems in arid regions: effective and efficient management of natural resources.

Fellow's Learning Objectives
- To research and understand the scientific methods and provide examples of its application in managing agricultural land in arid and saline conditions.

Research Background
Sustainable Development in Agriculture and climate change adaptation, Arid and Saharan agriculture development, Water Resources Management, Digital Mapping, Agroclimatology, Spatial Analysis of rainfall, Waste Management, and water management,

Expected Accomplishments
Agriculture arid and Saharan region is a large-scale agricultural enterprise that defies climatic and edaphic conditions based on the availability of groundwater resources and human intelligence. How to take advantage of these billions of cubic meters of water buried in the subsoil without damaging the environment and ensuring sustainability in time and space? Increase food production and increase local and participative development by introducing innovative technologies. Learn more about demineralization of brackish water and managing organic matter to improve soil quality.

Contributions to Algerian Agriculture Sector
The Fellow hopes the training will give them the tools to help guide farmers in participating in the process of identifying crops that are best suited to the Saharan environment and climatic conditions could yield tangible results and extend the impact to other regions. There is a need to generalize this incentive to help decision-makers to better redirect and frame their development strategies by adopting a participatory policy. Also, it is interesting to learn, to correct and to innovate in order to propose new practices that are respectful of the environment and easy to implement. In addition, the establishment of the living-lab is also seen as an initiative to identify the water productivity of crops and thus tolerance of some crops with respect to water and soil salinity. Encourage to using demineralization water technologies for agriculture at first stage for high value market crops by set up pilot and therefore generalize for other strategic crops.

Suggested Schedule

The applicant should propose a 12-week Fellowship schedule that reflects the researcher's goals and objectives as specified under this Scope of Work with a final schedule to be negotiated post award. This 12-week schedule should overlap with and include attendance for both Fellow and Mentor at the World Food Prize in October 2024.

Borlaug Fellowship Program – Algeria –Water Management – Fellow #2

Scope of Work
Fellow #2: Algeria, Male, Engineer, National Institute of Soil, Irrigation and Drainage, M.S., Biology Science

Goal
The Fellow's goal is to better understand water management in agricultural arid areas and best practices for desalination of brackish water and their use in agriculture.

Fellow's Learning Objectives
- Find the best practice and methods to benefit from brackish water desalination in agriculture, especially in arid and semi-arid regions in Algeria.
- Find the effectiveness mechanism to obtain good productivity water with low costs. The environmental conservation must be taken in account during any procedure or steps.
- Ensuring that using brackish desalinated water doesn't carry any issue or impact on agricultural production quality including human health.

Research Background
The Fellow's research background is in utilizing GIS and remote sensing technology for managing desalinated water with effective and efficient methods beside those modern techniques in irrigation systems through water management and of course building some models in order to protect the environment by conserving the underground water, catchment area, soil and vegetation, and of course to contribute in developing the agriculture by increasing the production with less costs.

Expected Accomplishments
The Fellow expects to learn new scientific techniques and methods on how to contribute and reuse desalinated brackish water as an alternative solution in irrigation while reducing the costs and furthermore, gain as much as possible to benefit my country and share the knowledge with others.

Contributions to Algerian Agriculture Sector
The Fellow hopes that participating in the Fellowship will help to find new techniques in using desalinated water in irrigation in order to increase the agricultural productivity and achieve the food security in Algeria, including the participation in economic development with taking into account the conservation ecosystem and supporting the integrated agricultural sustainability.

Suggested Schedule
The applicant should propose a 12-week Fellowship schedule that reflects the researcher's goals and objectives as specified under this Scope of Work with a final schedule to be negotiated post award. This 12-week schedule should overlap with and include attendance for both Fellow and Mentor at the World Food Prize in October 2024.

Borlaug Fellowship Program – Ghana – Parasitoid Resistance – Fellow #3

Scope of Work
Fellow #3: Ghana, Male, Officer-in-Charge, Ministry of Food & Agriculture, M.S., Agricultural Science

Goal
The Fellow's goal is to identify the diversity of Tephritid Fruit Fly Species and Associated Parasitoids Across Mango Production Zones In Ghana.

Fellow's Learning Objectives
- To identify tephritid fruit fly parasitoids associated with mango production in the southern & transition zones in Ghana.
- To access the effectiveness of the identified parasitoids in the management of tephritid fruit flies of mango.

Research Background
Mango (Mangifera indica L.) is one of the crops which have assumed great economic importance in Ghana (Okorley et al., 2014). Its export has increased steadily between 2000 and 2019 (i.e. from 244 MT – 9405 MT). With a global market share of 1.43%, mango export between 2020 and 2021 grew by 78.3% with a total export value of US$ 57.7 million (in 2021) compared to US$ 32.3 million (in 2020). Ghana is ranked eleventh (11th) globally among mango exporting countries and it is the major mango supplier to the UK. However, mango is still inadmissible into the continental US because of tephritid fruit flies and mango stone weevil (Sternochetus mangiferae). Mango is the commercial fruit species that is severely infested by fruit flies and their management is extremely difficult and expensive because they have wide host range and also diverse. This suggest that their management require an Integrated Approach. Research has indicated that chemical control of tephritid fruit flies reduces crop losses by 40-60% and may cost US$ 688-915.2 per acre per year. With the increasing concern on food safety, the use of Biological Control Agents (i.e. natural enemies, predators and parasitoids) in fruit fly management has gain prominence. Parasitoids are organisms that have their young develop on or within another organism (called the host) and eventually killing it. Research has identified four (4) species of parasitoids (Fopius caudatus, Psyttalia cosyrae, Psyttalia concolor and Diachasmimorpha fullawayi) in the Northern Savannah Ecology of Ghana. However, as to whether all these species are present in the transition and southern zones of Ghana for mango production, it is not known hence the need for this study.

Expected Accomplishments
During the Fellowship, the Fellow hopes to accomplish a research study on Fopius arisanus, a close relative of Fopius caudatus which has been found in Northern Savannah zone of Ghana. This opportunity will help the Fellow to better identify the parasitoid, study its biology and also assess their effectiveness in managing the most common tephritid fruit flies (Bactrocera invadens and Ceratitis capitata) in Ghana. Thus, it will provide the Fellow with practical experience. This Fellowship is also expected to contribute greatly to their professional development.

Contributions to Ghanaian Agriculture Sector

The research findings when implemented will help to further contribute to the reduction of crop losses in mango production, increase crop yield, trading volumes and incomes of farmers. Also, once it is established that these parasitoids are very effective and efficient, their use will help reduce pesticide application and increase the safety of the fruits.

Suggested Schedule

The applicant should propose a 12-week Fellowship schedule that reflects the researcher's goals and objectives as specified under this Scope of Work with a final schedule to be negotiated post award. This 12-week schedule should overlap with and include attendance for both Fellow and Mentor at the World Food Prize in October 2024.

Borlaug Fellowship Program – South Africa – Sustainable Bio-innovation – Fellow #4

Scope of Work
Fellow #4: South Africa, Male, Project Manager, Technology Innovation Agency/ Biosafety SA, M.S., Genetics - Plant Breeding

Goal
Supporting the development of a regulatory framework for genome editing in South Africa that is science-based, pro-trade, and aligned with international best practices in support of sustainable Bio-innovation.

Fellow's Learning Objectives
- Assess the current state of the bioeconomy in South Africa and Africa, including the identification of key sectors and their growth potential.
- Conduct a comparative analysis of international best practices in bio-innovation and technology transfer to identify a model that can contribute toward improving the legislative framework.
- Investigate the barriers and challenges hindering the growth of the bioeconomy in South Africa, with a focus on policy, regulatory frameworks, and institutional support.
- Develop a draft paper that shares the lessons learned and provide recommendations for policy makers and regulators to encourage the development and use of alternative products and techniques as well as integrate relevant international agreements and initiatives from other government departments.

Research Background
In the bioeconomy, the Fellow aims to utilize biological resources, including plants, animals, and microorganisms, to produce a wide range of products and services as outlines within the South African Bioeconomy Strategy (South African Government. (2014)). This includes renewable energy, bio-based materials, pharmaceuticals, and more. Their research focuses on understanding the potential of biotechnology, genetic engineering, and other innovative approaches to enhance agricultural productivity and competitiveness in support of sustainable development in South Africa and Africa. By leveraging cutting-edge scientific techniques and innovation in line with the guidelines afforded in both the South African Bioeconomy strategy and the Agriculture & Agro – Processing Master Plan (AAMP), the Fellow can develop new crop varieties, improve disease resistance, and enhance overall agricultural productivity in a way that minimizes environmental impact and alleviate social challenges such as food security and poverty, unemployment, resulting in sustainable growth within the South African Bioeconomy (South African Government. (2014); Department of Agriculture, Land Reform and Rural Development. (2022)).

Expected Accomplishments
During the Fellowship program, the Fellow hopes to establish collaborations with experts and institutions in the United States to exchange knowledge and best practices in bio-innovation and agricultural biotechnology. They aim to learn from their experiences in developing and implementing policies that promote sustainable bio-economies. Additionally, they plan to gain insights into successful models of technology transfer, commercialization, and job creation in the

agricultural sector. The Fellow hopes to learn from the US and how they can serve as an example in some of the core components as listed (but not limited to) below:

Policy Development and Implementation:
South Africa can learn a lot from the United States when it comes to policy creation and implementation for genome editing technologies and sustainable bioeconomies. South Africa should develop a clear regulatory framework that assures safety, ethical concerns, and environmental preservation in order to properly execute such laws. To facilitate comprehensive and inclusive policy creation, interdisciplinary collaboration across government agencies, academia, industry, and public stakeholders should be encouraged. Adequate funds and resources should be committed for research and development in these areas, as well as for the development of scientific ability and the promotion of responsible innovation. Public dialogues, awareness initiatives, and education programs should be focused to increase public knowledge and involvement. Incentives and subsidies to encourage industry collaboration and investment would boost innovation and commercialization. Finally, participating in international partnerships and information sharing networks would be beneficial.

Innovator Traits:
The United States has a strong culture of innovation, characterized by traits such as risk-taking, entrepreneurial spirit, and collaboration between academia, industry, and government. South Africa can encourage innovator traits by fostering an ecosystem that supports entrepreneurship, provides access to funding and resources for research and development, and promotes collaboration between different stakeholders. Learning from the U.S. approach, South Africa can build on their establishment of innovation hubs, technology transfer offices, and funding programs that support bio-based innovation.

Institutional Support:
The United States has well-established institutions that provide support for bioeconomy initiatives. For example, the National Institutes of Health (NIH), the National Science Foundation (NSF), and the United States Department of Agriculture (USDA) provide research grants and infrastructure to advance bio-based research and development. The Fellow hopes to engage with these institutions to build a collaborative relationship and learn from their approaches to allow them to share these within SA.

Choice of Products:
The United States has strategically chosen certain products for development and commercialization within the bioeconomy. South Africa can adopt a similar approach by assessing its own resources, strengths, and needs to identify the value proposition of gene edited products that can contribute to a sustainable bioeconomy. For example, South Africa has significant agricultural resources, and it can explore the application of Genome editing and its products. By identifying and prioritizing specific products for development and commercialization, South Africa can align its efforts with global sustainability goals and leverage its unique strengths to contribute to a bioeconomy that is beneficial for agriculture, health, and the environment.
IP Management:

The United States has a robust system for intellectual property (IP) protection and management, which incentivizes innovation and investment in the bioeconomy. South Africa can learn from this experience by strengthening its IP laws and regulations to protect bio-based inventions and foster a supportive environment for technology transfer and commercialization. This would encourage local innovators and attract foreign investment and partnerships.

Innovation Management:
The United States has frameworks for managing innovation, including regulatory oversight and public engagement. Regarding Genome editing technologies, the U.S. has guidelines and regulations in place, such as the Coordinated Framework for the Regulation of Biotechnology and the National Bioengineered Food Disclosure Standard. South Africa can develop its own frameworks that balance innovation with ethical, safety, and environmental considerations. This would involve establishing regulatory agencies and engaging the public and stakeholders in decision-making processes related to genome editing technologies.

Contributions to South African Agriculture Sector
This Fellowship or exchange program will contribute to enhanced agricultural productivity, economic development, and food security in my country by equipping the Fellow with the necessary knowledge and skills to drive sustainable bio innovation. Through informed policy recommendations, the Fellow can advocate for the adoption of gene editing and new breeding techniques, which have the potential to enhance crop yields, improve nutritional content, and increase resistance to pests and diseases. By promoting the responsible use of these technologies, the Fellow can create a more resilient and productive agricultural sector, leading to economic growth, job creation, and improved food security. Within their current mandate and role, the Fellow would be able to play a pivotal enabling role that will be to the advantage of the whole national innovation system.

Suggested Schedule
The applicant should propose a 12-week Fellowship schedule that reflects the researcher's goals and objectives as specified under this Scope of Work with a final schedule to be negotiated post award. This 12-week schedule should overlap with and include attendance for both Fellow and Mentor at the World Food Prize in October 2024.

Borlaug Fellowship Program – Morocco – Plant Genome CRISPR Technologies Editing – Fellow #5

Scope of Work
Fellow #5: Morocco, Female, Senior Chief Engineer Researcher, National Institute of Agricultural Research, PhD, Genetic Engineering

Goal
The fellow's goal is to identify the development of climate resilient crops using genome editing approaches.

Fellow's Learning Objectives
- Developing skills on Plant Genome Editing technology and gain practical experience of the entire workflow from designing the constructs to identification of mutant plants (Guide RNA design, Off-target analysis, CRISPR construct…).
- Develop CRISPR-Cas9 constructs targeting ATP Binding cassette proteins (ABC) gene in lentil to control Orobanche crenata
- Interact and develop project collaboration with scientists and share knowledge.

Research Background
Optimizing tissue culture protocols for mass production of several crops including fava bean and Argania spinosa and Ceratonia silique. Developing transgenic plants (legume and wheat) resistant to biotic and abiotic stress. This was accomplished using both Agrobacterium tumefaciens as well as biolistic bombardment. Genotyping Date palm to confirm cultivar identity of in vitro plants in an early stage of development. Genotyping methods developed in the Fellow's laboratory are currently used to certify asexually propagated date palm in several laboratories. Assessing genetic diversity and characterizing natural population of several economically important species such as date palm, Wild rose and Argania spinosa using molecular marker. This line of research is intended to be used to develop conservation strategies as well as identifying populations with economical potential. Recently, the fellow's research group has been working on establishing a genome editing platform that includes bioinformatics, constructs development, transformation and analysis of modified plants. The overall goal is to develop cultivars that are climate resilient with significant tolerance to abiotic and biotic stress. Examples of such challenges are: the parasitic plant Orobanche Crenata in lentil and Fusarium oxysporum albidinis in date palm. By employing gene editing techniques such as (CRISPR/CAS9) the Fellow hopes to generate edited crops that are resistant to these challenges.

Expected Accomplishments
The Fellow hopes to gain practical experience of the entire workflow from designing the constructs to identification of mutant plants (Guide RNA design and CRISPR modeling tools, Off-target analysis, CRISPR construct designing and analysis of CRISPR-edited events). Therefore, having full set of skills such that the Fellow can set up the relevant editing systems in the Fellow's own labs Develop CRISPR-Cas9 constructs targeting gene ABC genes in lentil and PSK gene in date palm. Develop RPA-Cas12a system with LFA to detect pathogen CAS Fusarium Gain experience in making NSG sequencing libraries to assess off target changes. Develop plant gene editing, Cas9 and Casl2a technologies for be routinely applied in multiple

plant species at Morocco and broadens their application Interact and develop project collaboration with scientists.

Contributions to Moroccan Agriculture Sector

Sustainable and resilient agriculture is a pillar of the "Generation Green" strategy to address climate change and ensure food security. Under the scenario of declining cultivable land and challenges posed by climate change, drought, salinity, high temperature stress and rapidly emerging plant pathogens, conventional strategies for crop improvement are limited. Thus, the integration of innovative technologies such as genome editing in cultivar development is imperative to achieve a quick and lasting improvement. Genome Editing Techniques (GED) represent a powerful toolbox (complementary to traditional breeding techniques) addressing current pressing challenges, including climate change. However, these techniques do not yet reach their potential in developing countries such as Morocco. So, through this fellowship program that provides training, science-sharing and collaborative research opportunities, the Fellow will develop new skills and advanced understanding of CRISPR-CAS technologies. This training will definitely help the fellow's group implement these technologies in their cultivar improvement programs in Morocco. Genome editing technologies is a promising approach for improving Moroccan staple crops including wheat, legumes, oilseeds and fruit trees with added value such as citrus and date palm as well as addressing climate and sustainability goals.

Suggested Schedule

The applicant should propose a 12-week fellowship schedule that reflects the researcher's goals and objectives as specified under this Scope of Work with a final schedule to be negotiated post award. This 12-week schedule should overlap with and include attendance for both Fellow and Mentor at the World Food Prize in October 2024.

Borlaug Fellowship Program – Morocco – Wheat Varietal Resistance to the Hessian Fly – Fellow #6

Scope of Work
Fellow #6: Morocco, Female, Researcher, National Institute of Agricultural Research, PhD, Entomology

Goal
The Fellow's goal is to identify the Molecular characterization of Moroccan Hessian fly populations and Wheat-Hessian fly interaction for the explore of gene editing technology to enhance wheat varietal resistance.

Fellow's Learning Objectives
- Determine the population genetic diversity and structure of Moroccan Hessian fly collected from main cereal regions using molecular markers (COI DNA gene) and SNPs.
- Assess the importance of the environmental and geographical components in explaining population differentiation.
- Study the virulent Hessian fly-wheat interaction using transcript profile analysis to reveal genes controlling insect resistance.
- Explore gene editing tools for breeding novel varieties with enhanced insect resistance.

Research Background
Wheat production is limited by many abiotic and biotic stresses that impact yield, among them pests. As the key pest of wheat, Hessian fly, Mayetiola destructor (Say), is a destructive pest of wheat worldwide. In Morocco, its damage has been estimated at 42% and 32% respectively, in bread and durum wheat. Hessian fly attacks can reach 100% during dry seasons, and it is mainly controlled by developing and deploying resistant wheat as the most effective, sustainable and economical mean of. Progresses have been made to develop and release resistant wheat cultivars with good resistance levels to Hessian fly populations in Morocco. However, Because of the highly specific gene-for-gene relationship between wheat and Hessian, the challenge for this control strategy is the development of new virulent biotypes under natural selection pressure that can overcome the resistance of specific genes after a large deployment over the years. In addition, the increase in global temperature present also a significant threat to the efficiency of some resistance genes, such as HI 1, Hl3, HS, conferring resistance under Moroccan conditions. To improve the varietal resistance durability in the long term, particularly with the presence of genetic variability between Moroccan Hessian fly, it is important to understand the genetic diversity the population structure, the importance of the environmental and geographic components on population structure and the mechanism of wheat- virulent HF interaction (avirulence and virulence genes). To achieve this goal, many molecular biotechnologies, such as mitochondrial DNA (mtDNA) sequences, single-nucleotide polymorphisms (SNPs) and transcript profiling, are widely used in such studies. These methods were used to examine genetic diversity and genetic differentiation level, frequency of gene flow between pest populations and phylogenetic analysis. For transcript profiling, it has been used to study differences in transcript levels based on genes that serve as key biomarkers during wheat resistance (incompatible interaction) and susceptibility (compatible interactions). Moreover, gene editing as a novel advanced technology, has been used to enhance wheat yield components and

resistance to biotic and abiotic stresses. The use of such cutting-edge technologies ensures global food, enhance the resilience of wheat production and minimize environmental pollution. Hence, the understanding of the Hessian fly population structure and the identification of gene markers of wheat resistance will facilitate the explore of gene editing for Hessian fly heat resistance. The objective of this research is 1/to conduct molecular characterization of Moroccan Hessian fly populations collected from the main cereal region, 2/ to assess virulent wheat-Hessian fly interaction. using advanced molecular tools and 3/to explore gene editing technology for breeding novel varieties with enhanced Hessian fly resistance.

Expected Accomplishments

Identification of Moroccan Hessian fly populations diversity and structure. To define the importance of the environment and geography components in population differentiation. Better understanding of Moroccan virulent Hessian Fly-wheat interaction to explore gene editing in wheat breeding for Hessian fly resistance.

Contributions to Algerian Agriculture Sector

Wheat is the main cereal in Morocco (4 million hectares), with an annual production ranging from 50 to 120 million quintals depending on climatic conditions (mainly rainfall). The development of this sector is one of the major objectives of the Moroccan agricultural strategy "Generation Green 2020- 2030". However, in arid and semi-arid regions, Hessian fly inflicts significant annual losses of more than 200 million DH annually. On the other hand, the investment in research to develop resistant varieties to this pest generates an internal rate of return of 39%. However, breeding combining several biotechnological approaches such as characterization and pyramiding resistant genes, is the best and powerful strategy to prevent the lost production.

Development of wheat resistant varieties to Hessian fly will improve yield and increase the income of Moroccan small farmers. Therefore, Morocco will take benefit from large cereal cultivated areas.

Suggested Schedule

The applicant should propose a 12-week Fellowship schedule that reflects the researcher’s goals and objectives as specified under this Scope of Work with a final schedule to be negotiated post award. This 12-week schedule should overlap with and include attendance for both Fellow and Mentor at the World Food Prize in October 2024.

Borlaug Fellowship Program – Morocco – Citrus Virus Detection – Fellow #7

Scope of Work
Fellow #7: Morocco, Male, Agronomic Engineer, National Institute for Agricultural Research, M.S., Agronomy

Goal
The Fellow's goal is to identify the Impact of climate change on the spread of plant disease, in particular the case of citrus leaf fungus and citrus viruses.

Fellow's Learning Objectives
- Investigate how temperature, humidity, rainfall patterns, and other climate factors influence the occurrence and severity of citrus leaf fungus infections.
- Investigating the impact of climate change on the transmission dynamics of citrus viruses
- Developing management strategies for mitigating the impact of climate change on citrus diseases

Research Background
Climate change is a major environmental challenge worldwide. In the Mediterranean area, climate change associated with enhanced temperatures and increased atmospheric CO2, influences the occurrence, prevalence, and severity of plant diseases. Climate change will thus affect the interaction between crops and pathogens in multiple ways. Citrus shoot and twig dieback is a disease that causes serious damage to citrus production worldwide. Several studies have shown that stress factors play an important role in the development of citrus shoot and twig blight (Riolo et al., 2021). Similarly for many viruses that require high temperatures for activation and spread, climate change is a key factor.

Expected Accomplishments
During this exchange program the Fellow hopes to acquire new knowledge in the detection of viruses and fungi using molecular techniques such as Real-Time PCR (qPCR) and genome sequencing, with a plan to install a sequencer in the Fellow's laboratory in the future.

Contributions to Moroccan Agriculture Sector
The Fellowship Program can contribute to enhanced agricultural productivity, economic development, and food security in Morocco in the following ways: Knowledge Transfer and Capacity Building: the Fellow will have the opportunity to acquire advanced knowledge, research techniques, and best practices in plant pathology and virology from a mentor in the United States. This knowledge can be applied to address agricultural challenges specific to Morocco, such as plant diseases and viral infections, leading to improved crop yields and productivity. Disease Management and Control: By working with a mentor in the United States, the Fellow can gain insights into effective disease management strategies, including disease surveillance, early detection, integrated pest management, and the use of resistant crop varieties. Implementing these strategies can help mitigate the impact of plant diseases and viruses, thereby improving crop health and productivity in Morocco. Research Collaboration and Innovation: the Program encourages collaboration and networking with researchers and institutions in the United States. This collaboration can lead to the development of innovative solutions for agricultural challenges in Morocco. By leveraging the expertise and resources available through the program,

the Fellow can engage in collaborative research projects, exchange ideas, and explore new approaches to improve agricultural productivity and address plant pathology and virology issues specific to Morocco. Technology Transfer: The United States is known for its advanced agricultural technologies and practices. Through the Borlaug Fellowship Program, the Fellow can learn about innovative technologies and their adaptation to the Moroccan context.

Suggested Schedule

The applicant should propose a 12-week Fellowship schedule that reflects the researcher's goals and objectives as specified under this Scope of Work with a final schedule to be negotiated post award. This 12-week schedule should overlap with and include attendance for both Fellow and Mentor at the World Food Prize in October 2024.

Borlaug Fellowship Program – Thailand – Genome Editing – Fellow #8

Scope of Work
Fellow #8: Thailand, Female, National Science and Technology Development Agency (NSTDA)/National Center for Genetic Engineering and Biotechnology (BIOTEC). PhD, Molecular Virology

Goal
Development of a versatile plant genome editing toolbox to enhance rapid evaluation of genes associated with fruit ripening and plant pathogens.

Fellow's Learning Objectives
Objectives include hands on experience on the use of advanced tools in CRISPR vector construction, development of a modular-based system of constructs targeting functional proteins, and more specifically, nucleases, which would facilitate functional genomic studies and develop tools to evaluate the integrity of CRISPR vector constructs.

Research Background
Plant genome editing, or gene editing, is a technology that allows specific and precise modification of gene or molecules that control expression resulting metabolomics, biochemical, physical or phenotypic changes in plants. The changes produce new and valuable plant varieties. In addition, the technology has applications in functional genomics through screening and identifying potential genes/molecules based on genome editing induced changes in plants. To effectively and rapidly develop and routinely conduct genome editing, a modular-based system of constructs that allow rapid customization of constructs for specific plant species, transformation, regeneration and evaluation strategies of genome edited plants would be invaluable.

Expected Accomplishments
Advanced techniques in CRISPR vector construction, plant genome editing toolboxes, and collaboration between Thai and US research scientists in plant genome editing and functional genomic studies.

Contributions to Thailand Agriculture Sector
Plant genome editing technology can be applied to production of new plant varieties, improvement of breeding programs and screening of germplasm. These applications can enhance plant productivity and food security in Thailand.

Suggested Schedule
The applicant should propose a 12-week Fellowship schedule that reflects the researcher's goals and objectives as specified under this Scope of Work with a final schedule to be negotiated post award. This 12-week schedule should overlap with and include attendance for both Fellow and Mentor at the World Food Prize in October 2024.

Borlaug Fellowship Program – Thailand – Plant Genome Editing – Fellow #9

Scope of Work
Fellow #9: Thailand, Female, National Science and Technology Development Agency (NSTDA)/National Center for Genetic Engineering and Biotechnology (BIOTEC) PhD Cell Molecular Biology

Goal
Improvement of genetic transformation technology for plant genome editing.

Fellow's Learning Objectives
To improve the genetic transformation system for plant gene editing of target genes including learning how to develop the vector plasmid which is useful for plant genome editing.

Research Background
The fellow's research background is plant breeding via biotechnology especially plant tissue culture. The responsibility is to develop the tissue culture approaches for plant breeding such as double haploid technology, somatic embryogenesis system for genetic modification and for mass production for medicinal plant via temporary immersion bioreactor.

Expected Accomplishments
To acquire knowledge on the approach for plant breeding with the gene editing system that can this technique for improve the economic traits of target plant. The fellow is beginning to work on rice gene editing using CRISPR/cas9 and the system of genetic transformation seems to be very difficult to generate the edited lines. The Fellow is looking for the opportunity to get training on various methods for genetic transformation that can then be used for establishing the platform technology of plant gene editing for Thailand in near future.

Contributions to Thailand Agriculture Sector
Skills acquired in the Program will translate to building capacity to work on plant genome editing especially in plant breeding program and gene functional genomics. The knowledge and incredible skill on gene editing will enhance the functional genomics work for gene characterization and be useful for develop the new breed cultivars which can complete the value chain for each crop in world market.

Suggested Schedule
The applicant should propose a 12-week Fellowship schedule that reflects the researcher's goals and objectives as specified under this Scope of Work with a final schedule to be negotiated post award. This 12-week schedule should overlap with and include attendance for both Fellow and Mentor at the World Food Prize in October 2024.

Borlaug Fellowship Program – Malaysia – Organo-Mineral Fertilizer – Fellow #10

Scope of Work
Fellow #10: Malaysia, Female, Deputy Director, Malaysian Agricultural Research & Development Institute, M.S., Organic Agriculture

Goal
The Fellow's goal is to develop a highly efficient organo-mineral fertilizer by combining agricultural waste and minerals to improve nutrient use efficiency and crop production.

Fellow's Learning Objectives:

- To determine the optimal combination of agricultural waste and minerals to create a balanced and efficient organo-mineral fertilizer.
- To evaluate the effect of compounded organo-mineral fertilizer on crop performance.

Research Background
Fertilizers play a critical role in ensuring a steady food supply, particularly in Malaysia. The country has experienced a significant increase in fertilizer imports, reaching RM 4.45 billion in 2019 from RM 3.92 billion in 2017. These fertilizers are primarily used for essential food commodities like oil palm, rubber, rice, fruits, and vegetables. Any substantial rise in fertilizer costs directly impacts production and food pricing, emphasizing the need for research and development strategies to create cost-effective and environmentally friendly fertilizers that can strengthen Malaysia's food production systems. To achieve this objective, it is crucial to explore new sources of raw materials, such as agricultural waste, to develop high organic matter-based fertilizers. These fertilizers can be enriched with minerals to provide sufficient nutrients for crop production. In the tropics, combining organic and mineral fertilizers for sustainable long-term cropping is recommended. The judicious and balanced application of NPK fertilizers and organic matter amendment can lead to high and sustained crop yields. Organo-mineral fertilizers, which are composed of composite organic wastes and inorganic materials, have demonstrated significant benefits. They can enhance the efficiency of added mineral fertilizers and are produced commercially by fortifying or blending organic wastes (e.g., cow dung, poultry droppings, market refuse, plant residues) with inorganic materials like urea, rock phosphate and sulphate of potash. Organo-mineral fertilizers offer advantages such as low external input, affordability, ease of transportation, and gradual release of nutrients compared to other types of fertilizers. It can also be formulated from a 100% locally available source in Malaysia such as compost from agricultural waste and urea and empty fruit bunch ash which can be locally sourced. Enhancing the implementation of organo-mineral fertilizer application strategies requires tailored approaches that account for the unique fertilizer needs of diverse fields. Prioritizing the judicious utilization of locally available organic resources is essential for maximizing nutrient efficiency. These refined approaches contribute to the seamless and efficient execution of food security programs, ensuring optimal agricultural productivity and sustainability. This approach is particularly significant for large plantations in Malaysia, as they face environmental issues resulting from the excessive use of chemical inputs. The importation of mineral fertilizers has continuously increased, leading to economic strain through foreign exchange losses and inflationary effects. To remain competitive in the industry, it is crucial to strengthen research and development efforts in locally producing organo-mineral fertilizers.

Therefore, this project aims to formulate a highly efficient organo-mineral fertilizer that improves nutrient use efficiency and crop production.

Expected Accomplishments

To enhance plant nutrition using cutting-edge fertilizers, advancing sustainable agriculture and addressing global food security. To explore new sources of raw materials from agricultural waste to produce organic fertilizers, enrich the organic fertilizer using minerals, and novel fertilization techniques, develop efficient tactics for plant growth, and collaborate with interdisciplinary researchers. Objectives include deepening knowledge, gaining practical experience in fertilizer development, fostering collaboration, and sharing gained insights with a wider audience. Ultimately, the goal is to contribute to plant health and agricultural sustainability through comprehensive understanding and meaningful contributions.

Contributions to the Malaysian Agriculture Sector

By focusing on enhancing plant nutrition through new fertilizers made from locally available raw materials such as agricultural waste, this Fellowship or exchange program will contribute to increase agricultural productivity, economic development, and food security in Malaysia. By experimenting with new fertilization methods, the goal is to improve plant nutrient content and uptake efficiency, resulting in higher crop yields and higher agricultural output. This, in turn, will help economic development by increasing agricultural output, providing jobs, and supporting rural economies. Furthermore, the program's emphasis on plant health and nutrition will assist in ensuring the availability of healthy and high-quality food, improving Malaysia’s population's food security.

Suggested Schedule

The applicant should propose a 12-week Fellowship schedule that reflects the researcher’s goals and objectives as specified under this Scope of Work with a final schedule to be negotiated post award. This 12-week schedule should overlap with and include attendance for both Fellow and Mentor at the World Food Prize in October 2024.

Borlaug Fellowship Program – Malaysia – Microbial Lignocellulose Biofertilizer – Fellow #11

Scope of Work
Fellow #11: Malaysia, Female, Research Officer, Sarawak Biodiversity Centre, M.S. Environmental Science

Goal
The Fellow's aim is optimization and industrial production of microbial lignocellulose degradation enzymes for the conversion of biomass to biofertilizers.

Fellow's Learning Objectives

- To optimize the production of microbial lignocellulose degradation enzymes for the efficient conversion of biomass to biofertilizers via high throughput approaches
- To access the reproducibility of microbial lignocellulose degradation enzymes production at large-scale bioreactor

Research Background
Microbial enzymes are preferred due to their stability, catalytic activity, ease of production and optimization. The use of microbial fermentation as a production method for enzymes has a long history and continues to be a significant approach. The fermentation processes, coupled with advancements in bioprocess technology, have contributed to the success of industrial enzyme production. There are two approaches to using microbial enzymes to treat oil palm residues: microbial treatment and enzymatic treatment. Direct interaction between enzymes and biomass makes direct enzymatic saccharification of biomass residues more efficient. For instance, enzymatic treatment typically takes around 72 hours whereas microbial treatment can take up to 40 days. SBC's NPL and Genome Database offer an excellent opportunity to further discover the capabilities of enzymes produced by microorganisms. The extensive collection of microbial strains, coupled with continuous genome sequencing efforts, provides a platform for identifying novel enzymes and expanding our understanding of their potential applications in various fields. The development of bioprocesses is typically a time-consuming and expensive procedure. Consequently, the availability of reliable and cost-effective high-throughput cultivation platforms is of paramount importance and serves as a central component in the process development chain. Shake flask cultivation has traditionally been used as an optimization method. However, its limited automation and labor-intensive nature hinder its efficient application in high-throughput approaches. Microtiter plate cultivation offers a promising and cost-efficient alternative to shake flasks, enabling an even greater number of parallel cultivations and extensively automated through the use of pipetting robotics with improved efficiency. To enhance the transferability of screening results to production processes, it is crucial to align the cultivation conditions during the optimization process as closely as possible to the final production conditions. This includes conducting screening cultivations in fed-batch mode, which better replicates the conditions employed in the actual production process. By mimicking the production environment, the screening results become more reliable and applicable to the subsequent production stages.

The utilization of oil palm biomass residues contributes to the production of greenhouse gases (GHGs), posing environmental concerns. However, adopting the circular economy concept

offers a solution to mitigate this problem. By transforming lignocellulosic biomass residues into value-added products, such as new crop nutrition products or fertilizer via enzymatic saccharification, the circular economy approach can help reduce the environmental impact and enhance the sustainability of the oil palm industry. The application of empty fruit bunch (EFB) as a mulching fertilizer substitute in plantations resulted in a GHG savings of 3.3 kg CO2eq per ton of EFB. Furthermore, utilizing EFB as a fuel for boilers displaced 2.0 kWh of electricity per kilogram of EFB, leading to a GHG savings of 1.1 kg CO2eq per ton of EFB. The recycling of mesocarp fiber (MF) and palm kernel shell (PKS) as fuel displaced 2.5 kWh per kilogram of MF and 3.6 kWh per kilogram of PKS of fossil energy, resulting in GHG reductions of 1.5 kg CO2eq per kilogram of MF and 2.2 kg CO2eq per kilogram of PKS, respectively.

Expected Accomplishments
Enhance existing skills and acquire new ones related to the optimization of microbial lignocellulose degradation enzyme production. This includes gaining proficiency in advanced techniques and methodologies used in the field, as well as improving the understanding of bioreactor operations to boost enzyme yields at a large scale to contribute to the development and implementation of efficient enzyme production processes. Broaden knowledge and understanding of microbial lignocellulose degradation enzymes, their industrial applications, and the overall bioprocessing field. This involves staying up to date with the latest research, innovations, and emerging trends in the industry. Given the importance of the Sarawak Bioindustrial Park (SBP), as the first bio park in Sarawak in promoting bio-industrial innovations and economic growth in green technology, the aim is to contribute to the establishment of an industrial-scale fermenter and production facility by playing a key role in optimizing the production of novel biomass degradation enzymes. Additionally, it includes implementing efficient strategies, identifying key parameters for enhanced enzyme yields, and establishing a robust downstream pipeline. Ultimately, the expectation is to facilitate the commercial production of these enzymes, supporting the development of sustainable biofertilizers and contributing to the growth of the biotechnology sector in Sarawak.

Contributions to Malaysian Agriculture Sector
Optimization of microbial lignocellulose enzymes for the conversion of biomass to fertilizers enhances agricultural productivity and the development of strong farming systems in Malaysia. To drive agricultural policy change, engage in sharing research findings through various avenues such as conferences, workshops, and policy discussions. By emphasizing the implications and potential impact of research on specific policy areas, the aim is to contribute to the development of evidence-based policies that effectively address significant social and environmental challenges and to influence policy formulation and foster positive change in line with the needs of society through active participation and dissemination of research.

Suggested Schedule
The applicant should propose a 12-week fellowship schedule that reflects the researcher's goals and objectives as specified under this Scope of Work with a final schedule to be negotiated post award. This 12-week schedule should overlap with and include attendance for both Fellow and Mentor at the World Food Prize in October 2024.

Borlaug Fellowship Program – Philippines – Rice Gene Editing – Fellow #12

Scope of Work

Fellow #12: Philippines, Male, Senior Science Research Specialist, Philippine Rice Research Institute, PhD, Agricultural Science

Goal
To receive training on the use of advanced gene editing tools, particularly SDN3 and/or Prime editing, to insert a long DNA fragment or a gene (e.g., *Sub1* for submergence tolerance, *Pi9* for blast tolerance, or *Bt cry1C* for stemborer resistance) into rice for better climate change resilience.

Fellow's Learning Objectives
The specific objective is to be able to apply SDN3 and/or Prime Editing in rice gene editing within the 3-month Fellowship period. The Fellow intends to produce rice plantlets that have successful insertion of the target gene as revealed by DNA sequencing. The target gene could be *Sub1* for submergence tolerance, *Pi9* for blast tolerance or *Bt cry1C* for stemborer resistance.

Research Background
The Philippines has recently made significant biotechnology strides by creating enabling policies and implementing guidelines (2018-2021) on the assessment and possible commercialization of products of gene editing and other new breeding techniques. Since 2020, there have been gene editing research being conducted at the Center (DA Crop Biotechnology Center), Philippine Rice Research Institute in Luzon, Philippines. The current targets are improving rice in terms of resistance to tungro and bacterial leaf blight, and grain quality. However, these and other gene editing initiatives in the Philippines mainly involve SDN1 (gene knockout) and there is still much to learn about the use of SDN2, SDN3 and Prime Editing (PE) that involve the insertion of genes or DNA fragments. Technical and applied knowledge of these advanced techniques can ensure that more traits can be edited out in Philippine crops, especially rice. The focus will be on SDN3 and/or Primer Editing to make gene insertions in rice.

Expected Accomplishments
The hope is to learn the basics of and successfully apply SDN3 and/or Prime Editing technique in rice gene editing through my actual exposure in the lab. Aside from technical skills and knowledge, as well as to gain new friends and future collaborators and cultivate a better understanding of the American scientific culture. The ultimate goal is to share knowledge with fellow researchers and scientists in the Philippines to contribute to the common goal of ensuring agricultural productivity.

Contributions to Philippines Agriculture Sector
The fellow personally leads the gene editing initiatives at the Philippine Rice Research Institute and the traits that we are working on (e.g., disease resistance, insect resistance, increased yield, etc.) are very much related to agricultural productivity and food security. The fellow also directly trains and mentors young researchers at the institution (and other individuals through lectures and seminars) who can also be leaders later; hence contributing to sustained economic development. They have also been involved in shaping the gene editing regulation in Philippines (since 2018) and through this fellowship, could better shed light on issues concerning biosafety and other technical issues; hence, facilitating the deployment and trade of modern biotech products.

Suggested Schedule

The applicant should propose a 12-week fellowship schedule that reflects the researcher's goals and objectives as specified under this Scope of Work with a final schedule to be negotiated post award. This 12-week schedule should overlap with and include attendance for both Fellow and Mentor at the World Food Prize in October 2024.

Borlaug Fellowship Program – Philippines — Rice Gene Editing – Fellow #13

Scope of Work
Fellow #13: Philippines, Male, University Researcher II, National Institute of Molecular Biology and Biotechnology (BIOTECH) MS Molecular Biology and Biotechnology

Goal
This research aims to utilize advanced gene editing techniques, such as Site Directed Nuclease (SDN2, SDN3), and prime editing, to enhance agricultural productivity in rice cultivation in the Philippines by introducing desirable traits for improved yield, disease resistance, and nutritional content.

Fellow's Learning Objectives
- To gain a comprehensive understanding of advanced gene editing techniques, including SDN2, SDN3, and prime editing, and their potential applications in rice cultivation
- To identify specific traits in rice crops that can be targeted for enhancement through gene editing, focusing on traits related to yield, disease resistance, or nutritional content
- To develop practical skills and hands-on experience in performing gene editing experiments using advanced techniques, including the design and execution of gene editing protocols for targeted trait modification in rice plants
- To evaluate the initial effectiveness and safety of gene-edited rice plants through preliminary laboratory assessments, such as PCR analysis and phenotypic observations.
- To document and present the findings and techniques learned during the 12-week training period, including recommendations for further research and potential applications of gene editing in rice cultivation in the Philippines

Research Background
Rice is an important crop in the Philippines, but it faces challenges like low yields and vulnerability to diseases. Advanced gene editing techniques offer a way to address these issues. Gene editing involves making precise changes to the DNA of plants, allowing scientists to introduce beneficial traits. In this research, the goal is to use advanced gene editing methods like SDN2, SDN3, and prime editing to modify the genes of rice plants, thus, the aim is to improve the productivity of rice crops by enhancing their ability to grow, resist diseases, and have better nutritional value.

Expected Accomplishments
During the Fellowship the expected accomplishments are to gain comprehensive knowledge and practical skills in advanced gene editing techniques for rice cultivation, enabling the Fellow to contribute to the enhancement of agricultural productivity in the Philippines through targeted genetic modifications in rice crops. Additionally, the aim is to establish valuable connections with experts in the field, foster collaborations, and create a network of agricultural stakeholders to facilitate future research and application of gene editing technologies in the Philippines.

Contributions to Philippines Agriculture Sector
This Fellowship will contribute to enhanced agricultural productivity, economic development, and food security in the Philippines in several ways. Firstly, by acquiring knowledge and skills in advanced gene editing techniques, the fellow can contribute to developing improved varieties of

rice crops that exhibit higher yields, resistance to diseases, and improved nutritional content. This will directly benefit farmers and increase agricultural productivity. Secondly, the application of advanced gene editing technologies can lead to the development of sustainable and resilient agricultural practices, reducing dependence on external inputs and promoting efficient resource utilization. Lastly, the enhanced agricultural productivity resulting from gene editing can positively impact food security by ensuring an increased and more reliable food supply for the population, ultimately contributing to economic development and prosperity in the country.

Suggested Schedule

The applicant should propose a 12-week fellowship schedule that reflects the researcher's goals and objectives as specified under this Scope of Work with a final schedule to be negotiated post award. This 12-week schedule should overlap with and include attendance for both Fellow and Mentor at the World Food Prize in October 2024.

Borlaug Fellowship Program – Vietnam - Genome Editing on Rice Resistant to the Bacterial Leaf Blight Disease - Fellow #14

Scope of Work
Fellow #14: Vietnam, Female, Deputy Dean – Lecturer, Vietnam National University of Agriculture, Faculty of Biotechnology, Department of Molecular and Applied Biotechnology, PhD – Agriculture/Global Food Security

Goal
The goal of the research is focused on genome editing on rice resistant to the bacterial leaf blight disease.

Fellow's Learning Objective
- To assay the bacterial leaf blight by artificial inoculation
- To construct a primer-editing vector for rice transformation using the PE5max system
- To analyze the genotyping of T0, Ti generation

Research Background
Rice production plays a crucial role in the agriculture sector of Vietnam due to the requirements of national food security and social economics. Unfortunately, rice production in Vietnam is facing with various challenges such as: the over-used of chemical pesticides and fertilizers, negative effects of global warming and climate change (flood, drought, salinity, hot temperature, and other biotic stresses), not having the broad-spectrum resistant varieties, and depending on seed providers. Therefore, it is essential to create the new varieties of rice resistant to bacterial leaf blight for Vietnam. There are different approaches to rice breeding. The resistance to bacterial leaf blight can be improved by integrating some resistant genes via crossing, screening and selecting, however, the efficiency is not high, and it is time consuming. Recently, the genome editing provided the powerful tools to create the new varieties through the system of edit the exactly targeted genes.

Expected Accomplishments
Vietnam is a rice production country. It is required to develop sustainably by using the resistant varieties, reduce and cut down using the chemical pesticides, fertilizers and other toxic compounds on rice field. This fellowship provides great opportunities to conduct the experiment on gene-editing to create resistant germplasm on rice, communicate with the professional network. Then, strategies to enhanced effective agricultural productivity and food security can be shared and transferred to my students and faculties. As a scientist working in the university, the Fellow will be able to contribute knowledge, connection and recommendation to the Faculty Dean board, University, and Presidency Board regarding the curriculum and research projects.

Proposed Schedule
The applicant should propose a 12-week Fellowship schedule that reflects the researcher's goals and objectives as specified under this Scope of Work with a final schedule to be negotiated post award. This 12-week schedule should overlap with and include attendance for both Fellow and Mentor at the World Food Prize in October 2024.

Borlaug Fellowship Program – Vietnam – Fellow #15 – Gene Editing for Climate Change

Scope of Work
Fellow #15: Vietnam, Male, Vice Head of Genetic Engineering Department, Agricultural Genetics Institute, PhD, Biotechnology

Goal
The main goal of this research proposal is to apply gene editing for important traits in crops in the era of climate change.

Fellow's Learning Objectives
- Objective 1: To identify the key traits related to climate change in crops can be improved or developed using gene editing techniques.
- Objective 2: To design and construct the required gene-editing vectors.
- Objective 3: To apply gene editing vectors to crops and assess results.
- Objective 4: To analyze and compile results.

Research Background
The research background focused on the transcriptional control of genes involved in tolerance to abiotic stress in crops. It involved using techniques in both in vitro and in vivo experiments. For these studies, a broad range of molecular biology, genetic engineering, and histochemical approaches were utilized. These studies also provided extensive DNA, RNA, and protein manipulation skills. Furthermore, research has been done in the field of gene cloning, transformation into plants (soybean and maize), transgenic event screening, and transgenic line analysis and evaluation.

Expected Accomplishments
Through this fellowship, the hope is to have a chance to gain a thorough understanding of the principles and techniques of gene editing such as CRISPR/Cas9, specifically, to develop expertise in the practical aspects of gene editing and able to gain experience in research to identify target genes and develop gene editing protocols to improve potential traits in crops, such as drought tolerance, heat tolerance, and efficient absorption of nutrients. Additionally, by collaborating with other researchers and stakeholders to develop and implement practical gene editing solutions for crop improvement that can effectively address food security challenges and reduce the impact of agricultural activities on the environment.

Contributions to Vietnam Agriculture Sector
Through the Fellowship program, gaining access to new gene editing technologies, techniques, and knowledge related to agriculture that can be applied to Vietnam's farming practices. This could lead to higher crop yields, better pest and disease management, more efficient water usage, and other benefits that directly enhance agricultural productivity in Vietnam.

Suggested Schedule
The applicant should propose a 12-week Fellowship schedule that reflects the researcher's goals and objectives as specified under this Scope of Work with a final schedule to be negotiated post award. This 12-week schedule should overlap with and include attendance for both Fellow and Mentor at the World Food Prize in October 2024.

Borlaug Fellowship Program – Vietnam – Fellow #16 – Water and Ion Conductivity in Barley PIP Aquaporins

Scope of Work

Fellow #16: Vietnam, Female, Lecturer, Department of High-Tech Agriculture, Faculty of Agronomy, University of Agriculture and Forestry, Hue University, PhD, Cell Physiological Study of Salt Tolerance in Poaceae

Goal

Distinct molecular mechanism of water and ion-conductivity in barley PIP aquaporins.

Fellow's Learning Objectives

- Identify the mechanism of ion and water transport mediated by PIP aquaporins and their regulation under stress condition (salt/drought) in rice and barley.
- To identify a genetic factor controlling Lpr
- To identify which aquaporin-gene is most important for salinity tolerance and/or yield and photosynthesis in rice and barley under salt stress
- To understand the functions and significance of aquaporins and their regulation in physiological processes under hypertonic stress by major environmental stresses such as salinity in rice and barley, then final identification of a master regulator controlling Lpr and ion transport activities via aquaporin.

Research Background

Salinity stress is a major abiotic stress, which decreases growth and productivity of glycophytes including crops. Soil salinity induces two independent factors. osmotic imbalance and ionic toxicity. The functions of PIP aquaporins have been found to be regulated by various molecular and cellular mechanisms including trafficking via heteromerization of PlP1 and PIP2 phosphorylation membrane internalization. Ionic stress is one of the most important components of salinity and is brought about by excess Na+ accumulation, especially in the aerial parts of plants. The transport mechanisms involve Na+ and/or K+ transporters and channels as well as non-selective cation change. Heterogenous expression of HvPIP2;8 and OsPIP2;4 in *Xenopus laevis* oocytes using two electrode voltage clamp (TEVC) experiment showed that among 12 barley PlPs (5 PIPI and 7 PIP2) and 11 rice PIPs (3 PIP1 and 8 PIP2) were examined, only HvPIP2;8 and OsPIP2;4 elicited largest currents permeable to Na+ and K+, but the ions transport activities were inhibited by external free Ca^2+ condition with ion transporting or HvPIP2;8 was less sensitive with external free Ca^2+ than OsPIP2;4 In general, our electrophysiological analyses of barley HvPIP and rice OsPIP aquaporins expressed in *X. aevis* oocytes have shown that HvPlP2:8 and OsPIP2A facilitates an ionic conductance at the plasma membrane in the presence of Na^+ and/or K+ in an external Ca^2+-sensitive manner. Respectively, co-expression of HvPIPls/l-lvPIP2;8 and OsPIPIs/OsPIP2;+ significantly reduced the HvPIP2;8/OsPIP2;Ll-dependent ionic conductance. *HvPIP2:8* transcript abundance increased in barley shoot tissues following salt treatments in a salt-tolerant cultivar Haruna-Nijo but not in salt-sensitive 1743. There is potential for HvPIP2:8 to be involved in barley salt stress responses and HvPIP2;8 could facilitate both water and Na+/K+ transport activity, depending on the phosphorylation status. In contrast, *OsPIP2:4* was predominantly expressed in root, especially in roots tips rather than stem, leaf sheaths, and leaf blades and other root parts. In addition, *OsPIP2:4* was mainly localized at epidermis and exodermis root tips, suggesting that *OsPIP2:4* may play important

roles in transporting water and ions from the soil into plants and the implications of CA2+ sensitivity could he happening at the root-soil boundary. Our manipulation of protein phosphorylation revealed that this channel is likely to be subject to complex regulation involving heteromerization and post-translational modification in HvPIP2;8. These findings progress our insight into the potential roles of plant aquaporin under salt stress and they are likely to inspire further research to uncover the molecular and structural mechanisms that control the dual permeability of aquaporin for ions and water and testing the physiological role of HvPIP2:8 and OsPIP2:4 *in plasma.*

Expected Accomplishments

This fellowship with the topic Biotechnology: Application of Gene Editing to Improve and Develop Resilient and Climate-Smart Traits in Crops. The program is a good opportunity to help a young scientist in agriculture field, improve knowledge and skills related to plant biotechnology. Moreover, the program will help understand more about gene technology to improve and development resiliency in crops in response to climate change.

Contributions to Vietnam Agriculture Sector

The Borlaug Fellowship Program will be a great help to enhance human resource development in Vietnamese agriculture to facilitate the transfer of new scientific and agricultural technologies to strengthen agricultural practices. Secondly, the effectiveness/potential of the fellowship have shown to the relevant authorities so that they can apply those results/potential to policies such as food safety management, economic growth, and collaborative research to improve agricultural productivity, economic development, and food security in Vietnam. From there. increasing agricultural productivity can be done sustainably and safely. and thus. promoting trade between Vietnam and the U.S. and other countries.

Suggested Schedule

The applicant should propose a 12-week Fellowship schedule that reflects the researcher's goals and objectives as specified under this Scope of Work with a final schedule to be negotiated post award. This 12-week schedule should overlap with and include attendance for both Fellow and Mentor at the World Food Prize in October 2024.

Borlaug Fellowship Program – Georgia- Animal Health - Fellow #17

Scope of Work
Fellow #17: Georgia, Male, Chief Specialist of Animal Especially Dangerous Infection Diseases Supervision Division, LEPL National Food Agency, MS Veterinary Science

Goal
Identify high-risk areas for Crimean-Congo Hemorrhagic Fever (CCHF) and risk-based intervention recommendations for Georgia by studying the role of animals in the transmission of CCHF, specifically looking at the prevalence of CCHF in cattle in areas where the circulation of CCHF is unknown, but human cases have been reported.

Fellow's Learning Objective
- To study the role of livestock in spreading the CCHF in Georgia.
- To identify high risk areas of CCHF in Georgia.
- To develop risk-based recommendations for both the municipal and country levels, defining what preventive measures should be taken in high-risk areas.

Research Background
Human CCHF cases have been expanding in both quantity and scope in Georgia with the spread into new districts and villages since 2009. From 2009 to June 2023, there were 180 laboratory-confirmed human cases of CCHF, 22 cases of which were fatal. 45% of cases since 2009 were reported between 2021-2023, and 2023's CCHF count has not yet been completed.
A seroprevalence study in cattle was conducted in 2019 covering 39 villages in 6 of the 12 regions of Georgia. The criteria for selecting villages was recorded human cases of CCHF in the epidemiological surveillance system. The results of the study confirmed the circulation of CCHF in all investigated villages except one, and IgG antibodies were detected in 407 out of 646 cattle. Positive results for CCHF indicates that the animal is a contributing link in the chain of spread of the virus (tick-animal-human) in the studied region. The overall prevalence of CCHF was 63%, confirming the active spread in the mentioned villages. Furthermore, this study found 0 out of 170 animal tick samples to be positive. These studies provide important information for future preventive measures, such as treating targeted animals with insecticides, and raising the awareness of the population. There is a need to study the prevalence of CCHF in cattle in areas where the circulation of CCHF is unknown, but human cases have been reported. As of January 2024, the number of such villages is up to 70.

Expected Accomplishments
The Fellow intends to identify the role of animals in the spread of CCHF and determine high-risk locations to help prevent the spread of the disease. The Fellow also intends to develop risk-based recommendations, for both the municipal and country levels, defining what preventive measures should be taken in high-risk areas. This can further prevent the spread of the disease and help with policy recommendations for future interventions.

Contributions to Georgia's Agriculture Sector

The prevention of CCHF is important for food security and economic development in Georgia. CCHF can be transmitted to humans through animal products resulting in many people becoming ill or dying from the disease. Twice a year both when leaving and arriving at the mountain pastures (in spring and autumn) the National Food Agency conducts an insecticide treatment for migratory livestock at 7 bio-surveillance points along the animal migration roads of 3 regions of Georgia. In addition, the agency conducts insecticide treatment of animals and cattle sheds in villages where human cases of CCHF are recorded. However, inappropriate use of insecticides increases economic costs and causes harmful effects to the environment. The results of this research will help target the use of drugs to reduce the harmful effects on the environment and the financial costs of treatment. The detection of risk zones will help Georgia carry out properly selected and timely preventive measures, both for migratory animals and those remaining in place, which will reduce the possibility of human disease. Better informed planning of animal insecticide treatments in risk areas can also prevent the spread of CCHF. Finally, the research will inform the creation and execution of awareness campaigns with target populations in the high-risk areas identified by the research.

Proposed Schedule from Applicant Proposal

The applicant should propose a 12-week fellowship schedule that reflects the researcher's goals and objectives as specified under this Scope of Work with a final schedule to be negotiated post award. This 12-week schedule should overlap with and include attendance for both Fellow and Mentor at the World Food Prize in October 2024.

Borlaug Fellowship Program – Türkiye –Biotechnology- Fellow #18

Scope of Work
Fellow #18: Türkiye, Male, Assistant Professor, Koc University. PhD Molecular and Cellular Biology, PhD Chemical and Biological Engineering

Goal
Development of lentil cultivars with varying capacities for engaging with microorganisms through CRISPR/Cas9-mediated genome wide targeted mutagenesis

Fellow's Learning Objective
- In this project, the Fellow proposes to develop novel lentil genotypes by genome-wide CRISPR-based mutagenesis approach and screen them for resistance to Fusarium wilt and root rot and efficiency of symbiotic nitrogen fixation and arbuscular mycorrhiza.

Research Background
As natural and healthy protein sources, leguminous crops are considered as alternatives to meat and animal products. Since the production cost of legumes are relatively low, legume-rich nutrition is a good strategy to cope with malnutrition in developing countries whose inhabitants cannot afford diets rich in animal proteins. Even in developed countries, health-conscious consumers have recently developed interest in pulse crops because of their essential amino acids content. Finally, consumption of legumes rather than of animal products reduces the risk of obesity, diabetes, and cardiovascular diseases. Lentils (Lens culinaris Medik.) are a legume crop that contains high amounts of dietary proteins, fiber, prebiotic carbohydrates, minerals; especially zinc and iron, and vitamins like folate. All these positive traits have contributed to an increase in global lentil production from 0.85 to 6.53 Mt since the 1960s. Lentils are cultivated in many regions of the world, especially in Canada (2.9 Mt) and India (1.2 Mt). Because lentils are a suitable crop for farm and diet sustainability, lentil cultivation is expected to increase in Türkiye and elsewhere around the world. As a cool-season crop, the growth and development of lentils is highly susceptible to high moisture and temperature. During vegetative growth it needs low temperatures, while during the maturity stage lentils thrive in relatively warm temperatures (18-30°C). Lentil agriculture depends on the amount and distribution of rainfall and does not require irrigation. Although their productivity per acre (1.17 t/ha) may be low compared to other crops, lentils are highly suitable for farming under global warming-induced water-limited conditions. As a legume, lentils can obtain and store usable forms of nitrogen in their roots by forming symbiotic interaction with nitrogen-fixing soil bacteria. This ability makes lentils a nitrogen-rich green manure and a significant rotational crop for sustainable agriculture which improves soil nutrient composition quality. In addition, lentil farming increases carbon sequestration more than other rotational crops, so the usage of lentil in cereal-based cropping systems results in the lowest carbon footprint. Taking all factors into consideration, growing lentils is a good strategy to enable sustainable agriculture under the influence of global warming-induced climate change to feed the world population. In addition to abiotic stresses, the growth and development of lentils are influenced by interactions with beneficial and harmful microbes. Lentils undergo symbiotic interaction with rhizobia and arbuscular mycorrhizal fungi (AMF) for nitrogen (N) and phosphate (P) acquisition and the success level of these associations determine the efficiency of nutrient uptake required for production of biomass and grain. However,

microbial diseases such as ascochyta blight, fusarium wilt, anthracnose, stemphylium blight, rust, white mold, collar and root rots cause constraints in lentil growth, yield, and production. To overcome agricultural challenges in changing environmental conditions, the genetic diversity and productivity of lentils should be improved and sustained. So far, breeding programs have successfully resulted in lentil varieties with desirable traits, such as productivity, large seed size, higher resistance to ascochyta blight, and stemphylium blight. However, the lengthy conventional breeding methods for lentil improvement is limiting the selection for additional traits. Therefore, novel genome editing technologies open the possibility to accelerate the process of genetic gain and generation of novel lentil cultivars. This proposal involves the development of new lentil varieties through performing a CRISPR-based mutagenesis approach. This experimental strategy is meant to be more appropriate for the lentil genome compared to others approaches like chemical mutagenesis involving ethyl methanesulfonate (EMS) or T-DNA insertion because of the large genome size (3.7 Gbp) characterizing this species. The probability to induce a random mutation using these approaches would be rather low. Due to the low mutation probability in genes, a very large population would be needed to identify mutants with the phenotype of interest. In contrast, the CRISPR-Cas9 approach can target mutations on genes, thus increasing the chance to generate phenotypes of interest, even when screening a consistently lower number of individuals.

Expected Accomplishments
The Fellow intends to acquire knowledge on the tissue culture methods for whole plant transformation, focusing on legumes, if possible, specifically lentils.

Contributions to Türkiye's Agriculture Sector
The Fellow can apply his acquired expertise to improve agricultural productivity in Türkiye. Lentils are a staple crop and a significant source of nutrition for the population. By developing novel lentil cultivars with enhanced traits such as increased yield, improved disease resistance, and optimized nutrient utilization, the Fellow can substantially boost lentil production and meet the growing demand for this essential crop. This, in turn, will contribute to improved agricultural productivity and address the challenge of food scarcity. The knowledge and skills gained from the fellowship can be shared with other researchers, farmers, and stakeholders in Türkiye. This knowledge transfer can contribute to capacity building and the dissemination of best practices in crop improvement. It can empower local scientists and practitioners to adopt advanced technologies and contribute to the development of a robust agricultural sector.

Proposed Schedule from Applicant Proposal
The applicant should propose a 12-week fellowship schedule that reflects the researcher's goals and objectives as specified under this Scope of Work with a final schedule to be negotiated post award. This 12-week schedule should overlap with and include attendance for both Fellow and Mentor at the World Food Prize in October 2024.

Borlaug Fellowship Program – Türkiye –Climate Smart Agriculture- Fellow #19

Scope of Work
Fellow #19: Türkiye, Female, Environmental Engineer, Ministry of Environment Urbanization and Climate Change, Directorate of Climate Change, Department of Greenhouse Gas Mitigation Policies. MA in Environmental Management

Goal
Develop and implement sustainable agricultural practices and policies to mitigate and adapt to climate change, with a focus on carbon sequestration and nature-based solutions.

Fellow's Learning Objective

- The Fellow proposes an assessment of the carbon sequestration potential of different land use classes and agricultural practices, evaluating the feasibility of implementing result-based carbon farming initiatives, and studying the potential for nature-based solutions to increase carbon sequestration in the agriculture sector.

Research Background
Türkiye is both a regional agricultural leader, and the 7th largest agricultural producer globally. The country is in the Mediterranean region, which is predicted to be one of the regions most effected in the world by climate change. Rainfall and temperature patterns are already growing more irregular. The agriculture sector that is impacted by climate change, paradoxically, also contributes to climate change through the emission of greenhouse gases. In the year 2021, the agriculture sector in Türkiye emitted a substantial 72 million metric tons of CO2 equivalent, with 9.9 million metric tons arising from fuel combustion, as reported by the Türkiye's National Inventory Report 2023. As part of a global commitment to combat climate change, Türkiye is compelled to implement emission reduction measures across all sectors, including agriculture. Models forecast dramatic changes in agricultural production, which has already started to impact food security directly and indirectly. To combat the negative effects of climate change, short-, medium-, and long-term measures need to be taken, and action plans realized. Considering the multifaceted challenges, climate-smart agriculture (CSA) stands out as an effective approach. This approach not only mitigates emissions but also equips the agricultural sector to adapt to the evolving impacts of climate change. It is a critical strategy in the broader context of sustainability. Within this scope, Türkiye recently began the exploration of CSA from a government policy priority perspective. Disseminating the technology and methods to increase adoption are the main goal of government's policy action plans. The Fellow plans to gain a thorough understanding of climate-smart agriculture and Nature-Based Solutions during this research program. Her goal is to be well-equipped to offer practical guidance and recommendations to policymakers for implementing effective strategies. Specifically, she wants to explore successful practices in the U.S. to understand how they can be applied in Türkiye. Her primary focus will be on conducting an extensive literature review to gather insights into climate-smart agriculture, with a specific emphasis on best practices. A comprehensive report will be prepared, comparing the current policies implemented in the United States with those in Türkiye, and drawing parallels from similar countries. To enrich the analysis, selected agricultural cooperatives and NGOs will be engaged in one-on-one discussions, delving into

their approaches to climate-smart agriculture and nature-based solutions. The practical implementation of existing policies will be analyzed, encompassing an exploration of advantages, disadvantages, challenges, and barriers. Post-analysis, potential economic benefits of carbon farming will be identified. A literature review on the global scale, particularly focusing on the United States and international perspectives, will bring the relationships between existing policies and nature-based solution approaches. The accrued data will then serve as the foundation for preparing a comprehensive article on sustainable and climate-smart agricultural activities, facilitating knowledge dissemination. Within the scope of the research, Stakeholder consultations will play a pivotal role, facilitating in-depth discussions with policymakers and decision-makers, and seeing activities firsthand, ultimately resulting in the formulation of a well-informed policy document designed to meet the unique needs of Türkiye. The Fellow plans to utilize the unique position of the Directorate of Climate Change, which holds exclusive authority in determining climate policies in Türkiye, to disseminate the findings and recommendations of her research. Serving as the UN Framework Convention on Climate Change (UNFCCC) focal point, the Fellow's directorate's responsibilities span the preparation and implementation of all climate-related policies, ensuring the realization of Türkiye's international commitments. Additionally, the coordination of Türkiye's climate change policies, including Nationally Determined Contributions (NDC) and Long-Term Strategies (LTS), involves consensus decisions within the "Climate Change and Adaptation Coordination Board," where all relevant institutions, including ministries, the private sector, and NGOs, are members. This board is chaired by the Fellow's ministry.

Expected Accomplishments

The Fellow intends to use her research to develop a well-informed policy document designed to meet the unique needs of Türkiye that harmoniously integrates climate-smart agriculture and nature-based solutions tailored to the Turkish context and is informed by an examination of United States practices and potentially similar country studies. This will be a pivotal step toward implementing effective strategies for enhanced agricultural productivity, economic development, and food security in Türkiye.

Contributions to Türkiye's Agriculture Sector

The understanding of greenhouse gas and carbon sink concepts, particularly in the agricultural sector, is often challenging for stakeholders in Türkiye. Given the considerable agricultural land area of 22 million hectares and the significance of soil carbon measurements, creating a carbon sink is considered crucial. Türkiye has great potential, and the Fellow's research aims to serve as a pivotal contribution to showcasing this latent strength. The Fellow's research will shed light on Türkiye's capacity to practice climate smart agriculture, drawing parallels with international examples, notably from the US. She intends to emphasize the importance of this capacity to Turkish policymakers through economic analyses, proposing strategies and actionable recommendations. This work aims to serve as a foundation for decision-makers, policymakers, and relevant institutions like the Ministry of Agriculture and Forestry.

Climate-smart agriculture methodologies continue to face global hesitation and uncertainty, and Türkiye is no stranger to this prevailing challenge. However, within the agricultural sector in Türkiye, the demonstration of exemplary practices has an optimal strategy for fostering widespread adoption. The insights and experiences gained through this program, coupled with the Fellow's research in Nature-Based Solutions and climate-smart agriculture, will position her

to effectively express the advantages of these practices to both policymakers and producers in Türkiye. The Fellow aims to use her acquired knowledge as a catalyst for transformative change. By describing tangible examples, success stories and best practices, her objective is to contribute to green transformation, influencing policy decisions and catalyzing the widespread adoption of climate-smart agricultural practices throughout Türkiye.

Proposed Schedule from Applicant Proposal

The applicant should propose a 12-week fellowship schedule that reflects the researcher's goals and objectives as specified under this Scope of Work with a final schedule to be negotiated post award. This 12-week schedule should overlap with and include attendance for both Fellow and Mentor at the World Food Prize in October 2024.

Borlaug Fellowship Program – Colombia – Genomic tools in Oil Palm (Elaeis guineensis and Elaeis oleifera) Breeding Program - Fellow #20

Scope of Work
Fellow #20: Colombia, Male, Researcher, Oil Palm Research Center - Centro de Investigación en Palma de Aceite (CENIPALMA); PhD in Plant Breeding & Crop Production and Physiology

Goal
To learn new skills in modern genomic tools used to optimize breeding programs, focused to know statistical models in this knowledge area and their practical implementation.

Fellow's Learning Objective
- Finding the optimum training set size to accomplish reliable levels of predictive ability of the unobserved genotypes.
- Development of models that include the interaction between genes and time for improving the predictive ability of the conventional genomic prediction models.

Research Background
In oil palm, the evaluation performance and trait discovery may last about 20 years or more because of the perennial nature of the crop. Genomic selection (GS) is a tool that uses molecular markers across the genome to improve trait prediction through the genomic estimated breeding value (GEBV). In palm oil, GS has been suggested as a way to reduce the length of the breeding cycle. GS is currently being used in crop breeding across the United States. A research project in collaboration with USDA focused on Colombia's palm oil industry would support this important agricultural sector in Colombia. Reducing breeding cycles could help reduce deforestation in Colombia by helping palm oil plantations finding more productive cultivars, using less land towards an intensification production system. Oil palm is an alternative renewable source to fossil energy and metabolites. Through new technologies for speeding-up breeding programs, it will be feasible to release new cultivars more quickly to overcome limitations and develop new markets and opportunities in the Oil Palm agroindustry, thus all the oil palm chain will be impacted.

Expected Accomplishments
Conduct genomic prediction studies to i) optimize the allocation of resources of the in-field experiments with the use of optimum training set sizes for predicting unobserved genotypes using dense molecular markers thus reducing phenotyping costs; ii) incorporate the interaction between genes-and-time to significantly improve model's predictive ability of the unobserved genotypes.

Contributions to Colombian Agricultural Sector
In oil palm, which is a perennial species, the evaluation performance and trait discovery may take around 20 years or more. Genomic selection (GS) is a tool that uses Genomic Prediction models and molecular markers across the genome to improve trait prediction through the genomic estimated breeding value (GEBV). The main advantage of genomic selection is that it does not require planting genotypes in fields in every cycle to in order to select superior cultivars, rather helps predict their expected performance. Initially it requires phenotypic and

genomic data of a set of genotypes previously observed to be used at training set to predict the unobserved genotypes. Then, the predicted values can be used as surrogates of phenotypes needed to conduct the selection of superior genotypes. As expected, several factors might affect the performance of the prediction models (training set size, number of markers, quality of the phenotypes, environmental fluctuations, genotype-by-environment interaction, management, genotype-by-environment-by-management interaction, etc.) and these should be also studied before implementing genomic selection in breeding programs. In oil palm, GS has been suggested as a means to reduce the length of the breeding cycle. GS is amply used in crop breeding across the U.S.A. CENIPALMA is trying to develop genotypes that produce high-quality oil, among other secondary traits, that can also be utilized in the economy of Colombia. Thus, the development of these improved genotypes will be broadly adopted by producer in Colombia helping to significantly improve the economy of this sector while at the same time promote adoption of climate friendly crops. Establishing collaborative agreements to explore the possibility of partners to support research in genomic tools in the different breeding processes that CENIPALMA is currently developing in Oil Palm and to acquire new knowledge in this field to get new skills in this cutting-edge agriculture technology would be of great benefit to Colombian's agricultural sector.

Proposed Schedule

The applicant should propose a 12-week fellowship schedule that reflects the researcher's goals and objectives as specified under this Scope of Work with a final schedule to be negotiated post-award. This 12-week schedule should overlap with and include attendance for both Fellow and Mentor at the World Food Prize in October 2024.

Borlaug Fellowship Program – Peru – Softwoods, Architectural Technology and Structural Design - Fellow #21

Scope of Work
Fellow #21: Peru, Male, Professor, Antenor Orrego University (UPAO) / Technology, Structures and Construction Department; PhD Architecture - Digital Fabrication and Emergency Housing

Goal
Research for structural solutions to develop two housing prototypes using U.S. softwood & wood products as a construction material, due to its multiple advantages, to solve architectural problems that benefit specific Peruvian northern communities.

Fellow's Learning Objective
- Develop scale prototypes from complex shapes in such a way that digital fabrication technology, specifically, CNC machines, can be harnessed in the construction of those shapes.
- Use U.S. softwood products as a base construction material for prototypes.
- Apply said prototypes to the solution of problems of social and environmental interest.

Research Background
Peruvian researchers in academia can strengthen their knowledge on wood structural design and techniques developed in the United States to transfer best practices for wood construction as a suitable alternative for the Peruvian market. The program will focus on working with a research institution/university to promote U.S. wood products as a primary structural material due to its performance characteristics, energy efficiency, safety, durability, costs, and seismic/wind performance for the Peruvian market. This program would contribute specifically to economic development, to the extent that a wood construction industry can be consolidated through training in its use, so that the process is optimized, and the wood makes better use, because in the case of Peru, they have the raw material but not having the appropriate technology to enable the wood, this raw material many times is wasted. Currently in the world, wood is being revalued as a construction material in architecture and this makes it is feasible to promote research that leads to the creation of a construction industry with U.S. softwoods and wood products in Peru.

Expected Accomplishments
Research for structural solutions for two prototypes level using U.S. softwood & wood products as the main material.
Address two lines of research:
- Emergency housing (response to climate change effects)
- Rural housing (green neighborhoods in the highlands) influence demographic policies

This research will set the foundation for the expanded and improved use of U.S. softwood products for construction purposes. The research will feature real and timely innovative applications by developing two synclastic shape structures, at the scale prototype level, that uses U.S. softwoods and wood products as the main material.

Contributions to Peruvian Agricultural Housing Sector

The people in the highlands of Peru need sustainable and affordable housing. Using U.S. softwoods and technology, it would be possible to offer designs, kits, and other forms of technical expertise to assists the housing crisis of the Andean communities in Peru.

The research could help spread the use of U.S. softwood and wood products as a construction material in the future due to the substantial advantages it has compared to conventional construction systems. Peru has a shortage of affordable, safe, comfortable, and permanent housing. This research aims to target this problematic by offering a solution featuring U.S. products. The research could help spread the use of U.S. softwood and wood products as a construction material in the future due to the substantial advantages it has compared to conventional construction systems.

Proposed Schedule

The applicant should propose a 12-week fellowship schedule that reflects the researcher's goals and objectives as specified under this Scope of Work with a final schedule to be negotiated post-award. This 12-week schedule should overlap with and include attendance for both Fellow and Mentor at the World Food Prize in October 2024.