The Department of Agriculture (USDA) – Foreign Agricultural Service (FAS)
Global Programs

Notice of Funding Opportunity (NOFO)
2021 Norman E. Borlaug International Agricultural Science and Technology Fellowship – Mexico Initiative

NOTE: If you are going to apply for this funding opportunity and have not obtained a Data Universal Numbering System (DUNS) number and/or are not currently registered in the System for Award Management (SAM), please take immediate action to obtain a DUNS Number, if applicable, and then to register immediately in SAM at www.sam.gov. It may take 4 weeks or more after you submit your SAM registration before your registration is active in SAM. Detailed information regarding DUNS and SAM is also provided in Section D of this NOFO, subsection, Content and Form of Application Submission.

In addition to obtaining a DUNS number and registering in SAM, you must also obtain Level 2 eAuthentication to apply for this funding opportunity in ezFedGrants. You must submit an online form requesting access. Normally you will receive an email within 24 hours of your submission, if your request is approved. After this occurs, you will need to schedule an appointment with an LRA. Once you meet with the LRA, your Level 2 eAuthentication should be granted within 2 to 3 days after that meeting. See Section D of this NOFO for detailed information.

A. Program Description

BACKGROUND

Since 2004, the U.S. Congress has made funds available to the Borlaug Fellowship Program to advance USDA'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 Participants based on country-specific topics of importance to international agricultural trade. USDA then places Participants with U.S. research institutions for 10-12-week intensive programs. These programs are expected to contribute to the strategic goals and objectives of the Participant 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. 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 Participants after their departure from the United States.

SCOPE OF WORK
The selected institution will design and implement a training program to meet the Participant'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 Participant's proposed research and training objectives, and full descriptions are in the appendix which can be quickly accessed vis the link in the table:

Fellow specific objectives:

- Fellow 1 – Plant Growth Promoting Fungi for Crops Improvement: Bioprospecting as Biofertilizers and Biopesticides; Developing a Certification System for Biofertilizers and Biopesticides. (page 17)
- Fellow 2 – Fungi PCR and DNA Extraction and Methodology of Detection and Identification of Pesticides Via Gas Chromatography and Mass Spectrometry (GC-MS) of Fresh Vegetables; U.S. Standards for Pesticide Use. (page 20)
- Fellow 3 – Agricultural Products Trade Policy – Market and Trade Data Analysis of Grains and Agriproducts Traded Between the U.S. and Mexico. (page 25)
- Fellow 4 –Abiotic Stress Use to Increase Antioxidants/Bioactive Compounds and Heavy Metal Chelation in Tomato Plants. (page 29)
- Fellow 5 – Mycorrhizal Fungi Biofertilizers and Certification. (page 33)

PLACE OF PERFORMANCE

- The applicant is expected to host participants at a research facility on their campus in the United States.
- The Participant is expected to spend two to three days at the USDA in Washington DC at the commencement and at the end of their fellowship program to brief and debrief with key USDA officers. The mentor or PI will be expected to make all necessary travel arrangements as well as accompany the Participant during both trips.
- The mentor is expected to make a reciprocal visit of up to two weeks to the participant's home institution, which may be in a developing country.

Issued By
Foreign Agricultural Service, Global Program, Fellowship Program

Catalog of Federal Domestic Assistance (CFDA) Number and Title
10.777 Norman E. Borlaug Exchanges International Science and Technology Fellowship Program

Notice of Funding Opportunity Title
2021 Norman E. Borlaug International Agricultural Science and Technology Fellowship – Mexico Initiative

NOFO Number
USDA-FAS-10777-0700-10.-21-0001

Authorizing Authority for Program
Sec. 7139 of the Food, Conservation, and Energy Act of 2008 (7 USC § 3319j), as amended.

Appropriation Authority for Program
Further Consolidated Appropriations Act, 2020 (PL 116-94)

Announcement Type
New

B. Federal Award Information

Award Amounts, Important Dates, and Extensions

Available Funding for the NOFO: up to $300,000 total with individual awards being up to $60,000 each.

Projected Number of Awards: up to 5

Period of Performance: 24 months

Projected Period of Performance Start Date(s): January 1, 2021.

Projected Period of Performance End Date(s): December 31, 2022.
The award period of performance will begin January 1, 2021. However, the implementor has up to 15 months from the beginning of the award to ensure the Fellow begins his or her fellowship. The Fellow will have up to 3 months to complete the assigned work. Extensions, with or without cost, may be considered; please see Section H.

Cost Share or Match requirements: A cost match or cost share is not required.

Funding Instrument
USDA will enter into a cost-reimbursable agreement under 7 USC § 3319a with selected recipients. Program staff will maintain involvement in the administration of the Scientific Exchanges Program.

C. Eligibility Information

Eligible Applicants

Florida A&M University, DUNS: 623751831
North Carolina State University, DUNS: 042092122
Texas A&M University, DUNS: 847205713
University of Tennessee, DUNS: 133891015

Pursuant to 2 CFR 415.1(d)(2), each agreement will be less than $75,000.

A single mentor may not host two Participants simultaneously. Both the PI and the mentor must hold a position at an eligible U.S. institution.

Eligibility Criteria
All applicants must have an active registration in the SAM database at www.sam.gov – pending or expired registrants are not eligible. This requirement must be met by the closing date of the announcement and will not be waived. Please contact the program officer listed if you have questions about this requirement.

Maintenance of Effort (MOE)
MOE is not allowable.

D. Application and Submission Information

Key Dates and Times

Application Start Date:	November 6, 2020
NOFO Posted Date:	November 6, 2020
Application Submission Deadline:	December 7, 2020 at 11:59PM EST
Anticipated Funding Selection Date:	December 15, 2020
Anticipated Award Date:	January 1, 2021

Address to Request Application Package
This NOFO represents the full application information.

Applications will be processed through the ezFedGrants portal at https://grants.fms.usda.gov – prospective applicants are encouraged to register for this portal. Applicants that are unable to access the ezFedGrants portal should contact the program manager for alternative submission instructions. Note that if selected, registration is a requirement of performance.

Content and Form of Application Submission
- Required forms and certifications, including:
- SF-424 version, signed by the applicant
- SF-424A version. This should be accompanied by a detailed budget and a detailed budget narrative (NOTE: A budget narrative must be provided). All line items should be

described in sufficient detail that would enable FAS to determine that the costs are reasonable and allowable for the project per federal regulations. The cost categories should be explained in this manner:

- **Personnel**: Costs of employee salaries and wages. For each staff person, provide the name (if known), title, time commitment to the project as a percentage of a full-time equivalent (FTE), annual salary, and grant funded salary. Do not include the costs of consultants. Consultants are to be included under "Contractual."
- **Fringe Benefits**: Costs of employee fringe benefits unless treated as part of an approved indirect cost rate. Provide the method used to calculate the proposed rate amount. If a fringe benefit has been negotiated with, or approved by, a cognizant federal agency, attach a copy of the negotiated fringe benefit agreement. If no rate agreement exists, provide a breakdown of the amounts and percentages that comprise fringe benefit costs such as health insurance, FICA, retirement insurance, taxes, etc. Identify the base for allocating these fringe benefit expenses. (Attach the agreement to the application package.)
- **Travel**: Costs of project-related travel by employees of the applicant organization (do not include costs of sub-contractor or consultant travel). For each proposed trip, provide the purpose, number of travelers, travel origin and destination, number of days, and a breakdown of costs for airfare, lodging, meals, car rental, and incidentals. The basis for the airfare, lodging, meals, car rental, and incidentals must be provided, such as past trips, current quotations, Federal Travel Regulations, etc.
- **Equipment**: **Equipment is not permitted for this award.** Equipment is defined as any article of nonexpendable, tangible personal property having a useful life of more than one year and an acquisition cost which equals or exceeds the lesser of (a) the capitalization level established by the organization for financial statement purposes, or (b) $5000. For each type of equipment requested, provide a description of the equipment, the cost per unit, the number of units, the total cost, and a plan for use on the project, as well as use or disposal of the equipment after the project ends. An applicant organization that uses its own definition for equipment should provide a copy of its policy or section of its policy which includes the equipment definition.

NOTE 1: Acquisition cost means the net invoice unit price of an item of equipment, including the cost of any modifications, attachments, accessories, calibration and maintenance services, or auxiliary apparatus necessary to make it usable for the purpose for which it is acquired. Ancillary charges, such as taxes, duty, protective in-transit insurance, freight, and installation shall be included in or excluded from acquisition cost in accordance with the organization's regular written accounting practices.

NOTE 2: Prior to the purchase of equipment in the amount of $5000 or more per unit cost, the Recipient must obtain the written approval from FAS, unless the equipment was approved in the

initial award. The Recipient shall maintain an annual inventory, which will include a brief description of the item, serial number and amount of purchase for equipment purchased with grant funds, or received under a grant, and having a $5000 or more per unit cost. The inventory must also identify the sub-award under which the equipment was purchased. Maintenance and insurance will be the responsibility of the Recipient. Title of equipment will remain with the Recipient until closeout when disposition will be provided in writing by FAS within 120 days of submission of final reports.

- **Supplies**: Supplies are tangible personal property other than that included in the equipment category if the acquisition cost is less than the lesser of the capitalization level established by the non-Federal entity for financial statement purposes or $5,000, regardless of the length of its useful life. Specify general categories of supplies and their costs. Show computations and provide other information which supports the amount requested. A computing device is a supply.
- **Contractual**: Costs of all contracts for services and goods that further the work of the project. Sub-contractors, sub-awardees, and/or sub-grantees that do not perform technical work (i.e., landscapers, trash collectors, etc.) These costs belong under other cost categories such as equipment, supplies, construction, other, etc. Include third party evaluation contracts (if applicable) and contracts with secondary recipient organizations.
- Demonstrate that all procurement transactions will be conducted in a manner to provide, to the maximum extent practical, open and free competition. Identify proposed sub-contractor work and the cost of each sub-contractor. Provide a detailed budget for each sub-contractor that is expected to perform work estimated to be $25,000 or more, or 50% of the total work effort, whichever is less.
    - Identify each planned subcontractor and its total proposed budget. Each subcontractor's budget and supporting detail should be included as part of the applicant's budget narrative.
    - Provide the following information for each planned subcontract: a brief description of the work to be subcontracted; the number of quotes solicited and received, if applicable; the cost or price analysis performed by the applicant; names and addresses of the subcontractors tentatively selected and the basis for their selection; e.g., unique capabilities (for sole source subcontracts), low bidder, delivery schedule, technical competence; type of contract and estimated cost and fee or profit; and, affiliation with the applicant, if any.
    - All required flow down provisions in the award must be included in any subcontract.
    - In this section also include subgrantees. Provide information for each planned subgrant. Identify each planned subawardee and its total proposed budget. Include a brief description of the work to be performed

    - **Other Direct Costs**: Any other items proposed as direct costs. Provide an itemized list with costs and state the basis for each proposed item.
    - **Indirect Costs**: This will be a cost reimbursable agreement issued under 7 USC § 3319a. University indirect costs for cost reimbursable agreements are limited to 10% of modified total direct costs (MTDC).
- If applicable, complete and submit the SF-LLL Disclosure of Lobbying.
- A project narrative that includes the following elements:
    - Indicate the name of the institution applying to host the Fellow;
    - Indicate the training topic;
    - Provide a tentative training plan based on the training interests listed in the statement of work, including topics to be covered, possible field visits and other activities;
    - Please include a narrative description of the proposed training, how it will be administered and the role of the university faculty and support staff;
    - Provide a summary of relevant institutional capabilities for hosting international Participants in the applicable topic(s);
    - Briefly describe the expertise and international experience of the recipient in the group's field of interest and various countries;
    - Demonstrate understanding of cultural context and needs of the trainees;
    - Identify the expected skills or knowledge to be acquired by the Participants at the end of the program;
    - Briefly demonstrate flexibility in training plan to account for potential program changes and the ability to respond to unforeseen circumstances;
    - Include a quality assurance plan. This should include information on how unforeseen problems that can arise will be addressed.

The SF-424 and SF-424A can be completed within the ezFedGrants platform. However, the other required forms must be downloaded from the Forms sections on Grants.gov or will be sent to you upon request to the program officer(s) named in Section G.

Please be aware that OMB Memorandum 18-24: Strategies to Reduce Grant Recipient Reporting Burden has been approved. Various required forms needed to apply for Federal Financial Assistance no longer need to be completed individually at time of application. They are covered in the Financial Assistance Certifications Report.

Effective January 1, 2020, the Financial Assistance Certifications are a common set of certifications and representations required by Federal statutes or regulations in accordance with the grant's guidance under Title 2 of the Code of Federal Regulations (2 CFR 200.208 Certifications and Representations). Those non-Federal entities who intend to apply for, or are already recipients of Federal grants or agreements, must read and agree to the corresponding certifications and representations. Registrants who reply yes to the following question are required to keep these certifications and representations current, accurate, and complete as part of their entity registration.

FAS will verify in SAM.gov that the proper certifications are completed, and if they have not been, you will be contacted and directed to do so. Your award will not be issued until the proper forms are completed within the SAM.gov portal.

Unique Entity Identifier and System for Award Management (SAM)
Each applicant is required to:

(i) Be registered in SAM (https://www.sam.gov) before submitting its application;
(ii) Provide a valid DUNS number in its application; and
(iii) 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.

The Federal awarding agency may not make an award to an applicant until the applicant has complied with all applicable DUNS and SAM requirements and, if an applicant has not fully complied with the requirements by the time the Federal awarding agency is ready to make a Federal award, the Federal awarding agency may determine that the applicant is not qualified to receive a Federal award and use that determination as a basis for making a Federal award to another applicant.

FAS is using ezFedGrants, which is an electronic grants management system. Applicant(s) with electronic access are required to submit their applications electronically through the ezFedGrants portal. Before you can apply, you must have a DUNS number, be registered in SAM, and have access to the ezFedGrants website at https://grants.fms.usda.gov

Applicants are encouraged to register early. The registration process can take approximately four weeks to be completed. Therefore, registration should be done in sufficient time to ensure it does not impact your ability to meet required submission deadlines. **DUNS number.** Instructions for obtaining a DUNS number can be found at the following website: http://www.dnb.com/duns-number.html

The DUNS number must be included in the data entry field labeled "Organizational DUNS" on the Standard Forms (SF)-424 forms submitted as part of this application.

System for Award Management. In addition to having a DUNS number, applicants applying electronically through ezFedGrants must register with SAM. Step-by-step instructions for registering with SAM can be found here:

www.sam.gov

Failure to register with SAM will result in your application being rejected during the submissions process.

ezFedGrants System Access and Electronic Signature

Level 2 eAuthentication. The next step in the registration process is to obtain a Level 2 eAuthentication account that will allow access to the ezFedGrants system. Instructions

for getting a Level 2 eAuthentication account can be obtained by emailing ezFedGrants-cfo@usda.gov

If you experience any issues with self-registration or have eAuthentication-related questions, please contact the eAuthenticationHelpDesk for assistance:
By email to eAuthHelpDesk@usda.gov

Requesting a role in ezFedGrants. After obtaining eAuthentication, users will need a role in the system. Descriptions of the roles available and instructions on how to request a role can be obtained by emailing ezFedGrants@cfo.usda.gov.

Electronic Signature. Applications submitted through ezFedGrants constitute a submission as electronically signed applications. When you submit the application through ezFedGrants, the name of your Signatory Official on file will be inserted into the signature line of the application.

If you experience difficulties accessing information or have any questions please email the Helpdesk at ezFedGrants-cfo@usda.gov.

Intergovernmental Review
For state or local entities in the United States, an intergovernmental review may be required for U.S. domestic entities only. Applicant(s) must contact their State's Single Point of Contact (SPOC) to comply with the State's process under Executive Order 12372 (see https://www.archives.gov/federal-register/codification/executive-order/12372.html) Name and addresses of the SPOCs are maintained at the Office of Management and Budget's home page at:

https://www.whitehouse.gov/wp-content/uploads/2019/02/SPOC-February-2019.pdf

Funding Restrictions
Generally, funds may not be used in any manner that is prohibited by 2 CFR Part 200 and 2 CFR Part 400 or this funding opportunity notice.

Compensation for personal services (whether classified as personnel, contractual services, or any other form) may not exceed the pro-rated equivalent of Step III of the Executive Schedule. For calendar year 2019, this is $176,900 per year; $680.38 per day; or $85.05 per hour. Non-monetized fringe benefits are generally excluded from this ceiling, however, a federally-negotiated fringe benefits rate agreement may be required if fringe benefits appear to be unusually high.

FAS agreement funds may only be used for the purpose set forth in the award and must be consistent with the statutory authority for the award. Agreement funds and non-monetary 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 serving in any capacity (paid or unpaid) on any proposal submitted under this program. Federal employees may not

receive funds under this award. In addition, federal funds may not be used to sue the Federal Government or any other government entity.

In addition, this will be a cost reimbursable agreement issued under 7 U.S.C. 3319a; therefore, University indirect costs are limited to 10% of the direct costs.

These funds cannot be used for construction purposes, general purpose equipment (no particular scientific, technical, or programmatic purpose), scientific equipment exceeding $5,000 or more, entertainment, capital improvements, thank you gifts, or other expenses not directly related to the project

Management and Administration (M&A) Costs:
M&A costs are not allowable.

Indirect Facilities & Administrative (F&A) Costs
Indirect F&A costs means those costs incurred for a common or joint purpose benefiting more than one cost objective and not readily assignable to the cost objectives specifically benefited without effort disproportionate to the results achieved. By statute, indirect costs for cost reimbursable agreements cannot exceed 10% of direct costs.

Other Submission Requirements
All applications must be submitted electronically as indicated above.

E. Application Review Information

Application Evaluation Criteria

Prior to making a Federal award, the Federal awarding agency is required by 31 U.S.C. 3321 and 41 U.S.C. 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.

Confidentiality and Conflict of Interest
Technical and cost proposals submitted under this funding opportunity will be protected from unauthorized disclosure in accordance with applicable laws and regulations. FAS may use one or more support contractors in the logistical processing of proposals. However, funding recommendations and final award decisions are solely the responsibility of FAS personnel.

FAS screens all technical reviewers for potential conflicts of interest. To determine possible conflicts of interest, FAS requires potential reviewers to complete and sign conflicts of interest and nondisclosure forms. FAS will keep the names of submitting institutions and individuals as well as the substance of the applications confidential except to reviewers and FAS staff involved

in the award process. FAS will destroy any unsuccessful applications after three years following the funding decision.

F. Federal Award Administration Information

Notice of Award

Notice of award will be given to the institution via email. This email is not an authorization to begin performance. The notice of Federal award signed by the grants officer (or equivalent) is the authorizing document through electronic means. It should also indicate if there are any pass-through obligations that successful applicants are required to meet upon receiving award funds, including specific timeline requirements.

Administrative and National Policy Requirements

All successful applicants for all grant and cooperative agreements are required to comply with Standard Administrative Terms and Conditions for Federal Assistance Awards, which are on the FAS website at:

https://www.fas.usda.gov/grants-and-cooperative-agreements-administrative-general-terms-and-conditions

The applicable Standard Administrative Terms and Conditions will be for the last year specified at that URL, unless the application is to continue an award first awarded in an earlier year. In that event, the terms and conditions that apply will be those in effect for the year in which the award was originally made unless explicitly stated otherwise in subsequent mutually-agreed amendments to the award.

Before accepting the award the Recipient should carefully read the award package for instructions on administering the grant award and the terms and conditions associated with responsibilities under Federal Awards. Recipients 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.

Federal Financial Reporting Requirements

The Federal Financial Reporting Form (FFR), as known as the SF-425, must be submitted semi-annually, within 30 days after the end of each reporting period, and a final report within 90 days of the end of the agreement. The required form is available online at: https://www.gsa.gov/portal/forms/download/149786

Program Performance Reporting Requirements

Performance Progress Reporting must be filed semi-annually, within 30 days after the end of each reporting period, and a final report must be filed within 90 days of the end of the agreement and should include details the activities undertaken and progress made.

Performance Expectations

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

The host institution will 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 Participant with a mentor. The host institution will select an appropriate mentor for one-on-one work with the Participant for the duration of the program.

- The mentor will establish a professional relationship providing guidance and training in the Participant's research and studies.
- The mentor will work with the Participant 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 Participant during the program.
- The mentor will continue communicating with the Participant beyond the end of the program in the U.S. through the mentor visit.
- Mentor will submit semi-annual progress reports that indicate all program activities are conducted.
- The mentor may assign other faculty members to assist with Participant's training and research activities.
- The mentor may not be assigned to multiple Participants 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 Follow-up Visit

- The mentor visit is a required component of the Borlaug Fellowship Program.
- The mentor will work with the Participant to plan a follow-up visit to the Participant's home country. The trip should 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 Participant 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.

(4) Travel and Transportation

- The host institution must comply with the Federal Travel Regulations (41 CFR 300 et seq.).
- The host institution will provide round trip, economy class, international airfare from the Participant's home to Washington, D.C., and to the university.
- The host institution is responsible for arranging and purchasing all domestic travel related to the Participant's training program.
- The host institution will provide housing for the Participant 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 Participant to pay for his or her lodging expenses, whether thro ugh 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 Participant's use. The Participant 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 Participant with a bus pass or proper allowance for transportation expenses.
- When planning lodging options, the host institution should check with the Participant and account for any special dietary restrictions or preferences.

(5) Meals and Incidentals (M&IE)

- The host institution will provide each Participant 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 Participant must receive per diem within the first week of the program. The PI must inform the Participant and USDA/FAS immediately if this cannot be accommodated.

(6) **Emergency Health Insurance**

- The host institution will purchase emergency health insurance for the Participant for the duration of stay, as required for all J-1 Visa holders (22 CFR 62.14). Dates of coverage must include date of departure from home country to the university until date of arrival in home country from the university.
- The Participant will not be required to purchase his or her health insurance and then be reimbursed.
- The host institution will educate the Participant 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 Participant 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 Participant'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 Participant'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 Participant can be reached in the event of an emergency.

(8) Program

- The host institution will provide educational materials and supplies to each Participant necessary for their full participation in the program.
- The host institution will pay for all fees related to the Participant'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 Participant's training program.
- The host institution will ensure the Participant submits an interim and final report (2-3 pages each) to USDA/FAS before the Participant leaves the United States. Reports should include the following:
    - Summary of activities, accomplishments, and any problems encountered or overcome
    - Photographs, when possible
- The mentor ensures that the Participant completes the Program Evaluation.

(9) Orientation

- The PI/Training Coordinator will communicate directly with the Participant 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 Participant'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 mentors

GOVERNMENT FURNISHED ITEMS: USDA FAS will provide Participants with a DS-2019 for the Participant to request and obtain a J-1 visa.

Monitoring
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, FAS will review recipients' files related to the funded program.

As part of any monitoring and program evaluation activities, recipients must permit FAS, upon reasonable notice, to review 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 their program.

Close Out Reporting Requirements.
Within 90 days after the end of the period of performance, or after an amendment has been issued to close out a grant, whichever comes first, 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.

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 deobligated. Records must be retained for a minimum of three years after the final reports are submitted, as described in 2 CFR 200.333

The recipient is responsible for returning any funds that have been drawn down or reimbursed but remain as unliquidated on recipient financial records.

G. Awarding Agency Contact Information

Contact and Resource Information
For all general questions, contact:
Nicola Sakhleh; Director, Scientific Exchanges Branch
Hours of operation: 8:00 AM – 4:30 PM Eastern Standard Time
Telephone: (202) 690-2484
E-mail address: BolaugFellowships@usda.gov
1400 Independence Ave, SW, Room 3231-S; Stop 1031
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H. Additional Information

1. Extensions

Extensions to this program will be considered. Applicants may request a no-cost extension in order to complete all project activities. The request must be submitted 60 days prior to the expiration of the performance period. Requests for extensions are subject to approval.

2. Pre-Award Costs
The Recipient shall not, without prior approval from FAS, incur costs pertaining to the operation of the project, program, or activities prior to the approved project period.

3. Budget Revisions
a. 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 prior written approval.

b. The Recipient shall obtain prior written approval for any budget revision that would result in the need for additional resources/funds.

c. The Recipient is not authorized at any time to transfer amounts budgeted for direct costs to the indirect costs line item or vice versa, without prior written approval.

4. 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 FAS Program Manager to explain how that development occurred, as part of their request for guidance and/or approval. The Program Manager will review approval requests for program income on a case-by-case basis; approval is not automatic. Consistent with the policy and processes outlined in 2 C.F.R. Part 200, pertinent guidance and options, as determined by the type of recipient and circumstances involved, may be approved by the Grant Officer. 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.

Appendix

Borlaug Fellowship Program - Mexico – Plant Growth Promoting Fungi for Crops Improvement: Bioprospecting as Biofertilizers and Biopesticides – Fellow # 1

Scope of Work

Fellow #1: Mexico, Male, Research Professor, University of Mexico Valley, PhD, Microbiology

Goal
The fellow's research goal is to find green alternatives on crops improvement using plant associated fungi with plant growth promoting features.

Fellow's Learning Objectives

- Obtain fungal strains with high potential to be used in crops field as biofertilizers and/or biopesticides.

Research Background

The searching of green technologies options instead of using agrochemicals in crops fields has been emerging since a few years ago. It has been described that agrochemicals can cause a negative impact in the environment derived by the toxicity of themselves, agrochemicals can cause soil pollution, and aquifer contamination due to their leaching (Aktar et al., 2009). The use of plant associated microorganisms has acquired great importance since the researchers found that some microorganisms can help plants to growth in unfavorable conditions (soils with poor nutrients, soils with a high amount of salt, etc.) and also they can improve the fitness of the plants they are associated with (Lakshmanan et al., 2014; Woźniak & Gałązka, 2019).

There are several studies about beneficial bacteria used as plant growth promoters, in fact some of them have been studied and already used as biofertilizers and biopesticides in commercial products. It has been demonstrated that the use of these microorganisms truly help the crops fitness.
Fungi as plant growth promoting microorganisms have almost no studies in comparison with bacteria, but some studies have promising results in the use of fungi in the agronomy industry. They can make close interactions with plants and also, they can provide them with nutrients and protect the plants against weather conditions (like dehydration and high amount of salt), as well, they can protect the plants against pathogens (Hossain et al. 2017).
In our laboratory, we have studied maize associated fungi. We already have a collection of 97 filamentous fungi and 78 yeasts. We also have started plant growth promoting tests obtaining preliminary promising results of *Aspergillus*, *Penicillium, Trichoderma* and *Didymella* strains, this last discover like an endemic endophyte of maize. Nevertheless, these strains need more studies like quantification protocols of plants growth promoting features and seedling bioassays. This training could be useful to reinforce the knowledge about protocols for the selection of strains and tests for the elaboration of biofertilizers and biopesticides.

Bibliography
Aktar MW, Sengupta D, Chowdhury A, (2009). Impact of pesticides use in agriculture: their benefits and hazards. Interdiscip. Toxicol. 2: 1-12.

Hossain MM, Sultana F, Islam S, (2017). Plant growth-promoting fungi (PGPF): phytostimulation and induced systemic resistance. In: Singh DP, Singh HB, Prabha R (eds), Plant-microbe interactions in agro-ecological perspectives, Springer, Singapore, pp. 135-191.
Lakshmanan V, Selvaraj G, Bais HP, (2014). Functional soil microbiome: belowground solutions to an aboveground problem. Plant Physiol. 166: 689-700.
Woźniak M, Gałązka A, (2019). The rhizosphere microbiome and its beneficial effects on plants–current knowledge and perspectives. Adv. Microbiol. 58: 59-69.

Expected Accomplishments

1.Obtain training for select promising fungal strains and develop experiments in field and elaborate biofertilizers and biopesticides
2.- Acquiree knowledge about American federal regulations on production and selling of biofertilizers and biopesticides

Contributions to Mexican Agriculture Sector

Actually, in Mexico does not exist federal regulations about the protocols to evaluate microorganism and uses on biofertilizers and biopesticides making difficult the production or commercialization. In 2019, I was part of national committee of Mexican federal Normativity about biofertilizers legislation. This training could be useful for understand better standard procedures for improvement of these rules.

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.

Borlaug Fellowship Program for Trade Policy Initiative for Mexico

Week #	Work Subject	Summary	Materials needed
Week 1	Plant growth promoting characteristics of fungi *in vitro*	Growth the fungal strains and characterize the phosphate solubilization with a quantitative method.	Perti dishes Erlenmeyer flasks Spectrophotometer Tricalcium phosphate
Week 2	Plant growth promoting characteristics of fungi *in vitro*	Ammonia and indol acetic acid production with a quantitative method Antagonistic activities against phytopathogens	Petri dishes Erlenmeyer flasks Spectrophotometer Indol acetic acid Nessler reagent *Fusarium*,*Colletotrichum*, *Alternaria*, *Phytophtora*, *Rhizoctonia*, *Meloydoigine* strains
Week 3	Plant growth promoting characteristics of fungi *in vitro*	Siderophores production quantitative method	Petri dishes Erlenmeyer flasks Spectrophotometer CasS

			Metal salts
Week 4	Bioassay *in vitro*	Germination test on maize, chili and tomato seeds (these crops were selected due their faster growth time in comparison with others)	*Zea mays*, *Solanum lycopersicum*, *Capsicum annuum* seeds Erlenmeyer flasks Fungal strains
Week 5	Bioassay *in vitro*	Assay of fungi strains with plant growth promoting activities in laboratory	Crop seeds Erlenmeyer flasks Fungal strains Vermiculite
Week 6	Bioassay in greenhouse conditions	Evaluate the laboratory plant growth promoting results obtained Selection of the best fungal strains and crops Inoculation of axenic fungal strain	Greenhouse Crop seeds Fungal strains Vermiculite
Week 7	Bioassay in greenhouse conditions	Inoculation of co-culture fungal strains in the seeds of the selected crops	Greenhouse Crop seeds Fungal strain Vermiculite
Week 8	Bioassay in greenhouse conditions	Inoculation of axenic fungal and co-culture fungal strains with the capability of phosphate solubilization in the selected crops	Greenhouse Crops seeds Fungal strains Vermiculite
Week 9	Federal regulation rules Bioassay in greenhouse conditions	Learn about USA federal regulation rules about biofertilizers and biopesticides Start evaluating plant growth promotion results	Greenhouse Fungal strains Crops seeds Vermiculite
Week 10	Field studies	Learn about procedures of studies in field conditions	Crop field lands Regulation in field plant growth promoting studies
Week 11	Microscopy	Auxin reporter plant Fluorescence microscopy Histochemical stain	Confocal microscope Plant with gene reporters of auxins production Polarized light microscope
Week 12	Microscopy	Lasser-capture microdissection of endophytic fungi	Arcturus XT Laser Capture Microdissection (LCM) System

Borlaug Fellowship Program – Mexico – Fungi PCR and DNA Extraction; Methodology of Detection and Identification of Pesticides Via Gas Chromatography and Mass Spectrometry (GC-MS) of Fresh Vegetables; U.S. Standards for Pesticide Use – Fellow #2

Scope of Work

Fellow #2: Mexico, Female, Research Professor, Benemérita Universidad Autónoma de Puebla, MsC, Microbiology - Biochemistry and Microbial Genetics

Goal
The goal of the fellow's research is to learn methodologies for Cyclospora detection and second, the identification of pesticides with the same methodologies used in the U.S.

Fellow's Learning Objectives
- Learn methodologies for Cyclospora detection in fresh vegetables
- Learn methodologies to identify pesticides in fresh vegetables
- Learn methodology to detect and quantify pesticides by gas chromatography (gas / liquid) coupled with mass spectrometry (GC-MS)
- Establish protocols to be used back at home institution.

Research Background

In Tecamachalco, Puebla is located the "campus regional Tecamachalco" where I work as a teacher and researcher. Tecamachalco is a very important vegetable producing region mainly: onion, coriander, carrot, tomatoes, zucchini, chives, cauliflower, lettuce, spinach, broccoli and others , at the same time, has taken importance as an important region for the export market, being the main consumer country United States of America.

Unfortunately, in Mexico Inadequate agricultural practices are still deeply entrenched, even dangerous: non-composted fertilizers, use of agrochemicals not allowed and others. if this was not enough, we must also mention anomalies in the collection centers from receipt to packaging. during my research work I have detected situations that require attention and correction: poor quality of wash wáter, incorrect dosage of disinfecting agents, insufficient training in good manufacturing practices to mention the most important.

Situations of this kind have caused certain problems that have compromised exports of fresh vegetables produced here, like the restriction imposed by FDA to the marketing of coriander (*Coriandrum sativum) situation that since 2005* has generated losses for the farmers of the following municipalities: Acatzingo, Tepeaca, y Tecamachalco (https://www.eleconomista.com.mx/estados/Hay-200-productores-de-cilantro-afectados-por-restriccion-de-EU-20150730-0173.html) situation caused by outbreaks of Cyclospora affecting US consumers. It is a fact that this serious situation that has its origin in the cultivated fields has generated a global impact that must be resolved. It is for this reason that one of my investigations has set out to establish a detection technique for Cyclospora in water, workers (including farmers), Industrial facilities and finished products in order to combat this situation and generating benefits at different levels: a) offer sanitary quality products to customers, b) positioning as reliable suppliers, and c) improvement in the living conditions of farmers that they will see an improvement in their economic income by offering products with export quality, and in many cases stop depending from an intermediary to become exporters.

At the moment, progress has been identified orchards that have been involved and identified as presumed origins of this situations, and the proposed methodology (FDA) has been reviewed to carry out detection in our laboratories. Unfortunately, the health emergency due Covid-19 prevented further work in the laboratory hoping that son can continue this Project.

Another worrying situation and what does my work team propose to address is the correct detection, identification and quantification of pesticide residues in fresh horticultural products because this is another constant problem in the Mexican fields (another line of research from my team is to develop agroecological strategies of fertilization and pest control), being one of the objectives to establish within the food safety laboratory the methodology to identify these pesticides to offer it as a service to producers, allowing to establish strategies to solve this problem being gas chromatography coupled to mass spectrometry (GC-MS) the methodology to be used, currently in the laboratory a spectrometer is found and will be purchased son the gas chromatograph.

One of the objectives that I propose is get training with a U.S. researcher expert in this area. for what was said above the goal that I intend to achieve during my research stay is, first, know the methodologies for Cyclospora detection and second, the identification of pesticides with the same methodologies that in the importing country (USA) in order to establish upon my return the same conditions in my country and thus ensure that the methods be the same and ensure reliable and valid identifications for U.S. health authorities since it is of my interest support local farmers to achieve the production of high quality vegetables that do not present inconvenience for its correct and successful marketing. In this way I will contribute together with my university with the mission and social commitment that characterize us promoting community development.

Expected Accomplishments

- Establish within the food safety laboratory the methodology to identify pesticides and to offer it as a service to producers using gas chromatography coupled to mass spectrometry (GC-MS)
- Developing a research paper including statistical analysis and research conclusions to provide information to other researchers in the same research field.

Contributions to Mexican Agriculture Sector

The results of this research will provide a guideline and protocol document with methodologies to be used to detect pesticides in fresh vegetables, and to be distributed to Mexican farmers and collaboration with other researchers in this field, and to be used in communications with legislators and policy makers.

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.

Borlaug Fellowship Program for Trade Policy Initiative for Mexico

Week #	Work Subject	Summary	Materials needed
Week 1	Recognition of the work area, staff, equipment and methodologies related to research	This week I propose to know the facilities, meet the staff that works in the area, identify equipment location and begin to know the methodologies	- Laptop - Work log - Office supplies - Permission to enter the work area - Equipment operation manuals

			- Official methodologies for determinations
Week 2	Bibliographic review and evaluation of the research protocol	This week I I propose to carry out the research protocol review by expert researchers who will be my tutors and supervisors doing preliminary trials that allow me to identify myself with methodologies	- Access to computer equipment, procedure manuals and reference literature - Permits to operate the equipment (with expert advice) in order to perform preliminary trials. - Permission to enter laboratories and access to the corresponding reagents
Week 3	Reception and processing of samples	This week I plan to collect and processing samples (samples that come from Latin-American countries) preferably those involved in disease outbreaks and for pesticide identification those where they have also been reported anomalies	- General laboratory equipment - Access to material and equipment for DNA extraction - Access to material and equipment for purity verification and DNA concentration - Access to equipment and material to perform detection and quantification of pesticides by gas chromatography (gas / liquid) coupled with mass spectrometry (GC-MS)
Week 4	Analytical determinations and realization of the technique real time PCR.	This week they will take place planned determinations, performing the necessary repetitions and statistical analysis of data obtained	- Material and equipment to complete Cyclospora identification - Material and equipment for identification and measurement of pesticides through the proposed methodology
Week 5	Analytical determinations and realization of the technique real time PCR.	This week they will take place planned determinations, performing the necessary repetitions and statistical analysis of data obtained	- Material and equipment to complete Cyclospora identification - Material and equipment for identification and measurement of pesticides through the proposed methodology

Week 6	Analytical determinations and realization of the technique real time PCR.	This week they will take place planned determinations, performing the necessary repetitions and statistical analysis of data obtained	- Material and equipment to complete Cyclospora identification - Material and equipment for identification and measurement of pesticides through the proposed methodology
Week 7	Evaluation and discussion of the first results.	At this stage it is proposed that work on the data discussion with the experts to supervise my work, evaluating results and making the comments, corrections and adjustments as necessary	- Boardroom - Computer equipment for data analysis - Access to databases and other sources of consultation
Week 8	Analytical determinations and realization of the technique real time PCR.	This week they will take place planned determinations, performing the necessary repetitions and statistical analysis of data obtained	- Material and equipment to complete Cyclospora identification - Material and equipment for identification and measurement of pesticides through the proposed methodology
Week 9	Analytical determinations and realization of the technique real time PCR.	This week they will take place planned determinations, performing the necessary repetitions and statistical analysis of data obtained	- Material and equipment to complete Cyclospora identification - Material and equipment for identification and measurement of pesticides through the proposed methodology.
Week 10	Analytical determinations and realization of the technique real time PCR.	This week they will take place planned determinations, performing the necessary repetitions and statistical analysis of data obtained	- Material and equipment to complete Cyclospora identification - Material and equipment for identification and measurement of

			pesticides through the proposed methodology.
Week 11	Final evaluation of results and drafting of the final document	At this stage the discussion will take place with the statistical analysis and research conclusions that will be reflected in a scientific document that allows to provide information to other researchers .	- Access to computer equipment - Access to databases, information sources, statistical data analysis software - Access to cleaning supplies to deliver the work area in perfect condition
Week 12	Final evaluation of results and drafting of the final document. Delivery of facilities in good condition and clean	At this stage the discussion will take place with the statistical analysis and research conclusions that will be reflected in a scientific document that allows to provide information to other researchers and the work area will be cleaned	- Access to computer equipment - Access to databases, information sources, statistical data analysis software - Access to cleaning supplies to deliver the work area in perfect condition

Borlaug Fellowship Program – Mexico – Agro-Economics Market/Trade Data Analysis of Grains and Agriproducts – Fellow #3

Scope of Work
Fellow #3: Mexico, Male, Analyst/Researcher, Centro de Investigación y Asistencia en Tecnología y Diseño del Estado de Jalisco CIATEJ-CONACYT, PhD, Economics- Agroindustrial Problems

Goal
The goal of the fellow's research is to developed marketing research tools to analyze market and trade data of agricultural products.

Fellow's Learning Objectives

- The objective of the research will focus on identifying marketing analysis tools
- Define datasets, analyzes, spatial mapping, science and information on trade in grains and agro-products, etc. between Mexico and the United States.
- Collaborate with organizations, government institutions, academics and producers.

Research Background

The objective of my research will focus on identifying the new opportunities to transfer about structures of innovations for develop specific information in order to facilitate the datasets, analyzes, spatial mapping, science and information on trade in grains and agro-products, etc. between Mexico and the United States, collaborating with organizations and institutions with government, academic and producers.

The main topics that I want to do is foster collaboration and networking to improve agricultural productivity and trade and new technologies that can be applied in home institution. The training will be very useful to strengthen the lines of work in my current job. We have several research projects in the Southeast of the country where we are being developed with small rural producers, we have significant potential production of agricultural products with high value chain.

Likewise, the training will be very important for develop strategies of actions and design of public policies in the science and research sector, the training will increase the vision and strategies necessary to focus the actions and activities that I develop in the Laboratory of technological prospecting innovation in Food. In addition, the training will increase my abilities and skills to strengthen the strategies for construction of technological systems and platforms that facilitate access to the commercialization and generation of costs of agribusiness products m Mexico.

Expected Accomplishments

- Develop strategies of action and design of public policies in the science and research sectors
- Learn U.S. Methodology for market and trade analysis of agricultural products to be used by the ministry of agriculture.

Contributions to Mexican Agriculture Sector

The results of this training will be very important for develop strategies of actions and design of public policies in the science and research sector, the training will increase the vision and strategies necessary to focus the actions and activities that I develop in the Laboratory of technological prospecting innovation in Food. In addition, the training will increase my abilities and skills to strengthen the strategies for

construction of technological systems and platforms that facilitate access to the commercialization and generation of costs of agribusiness products m Mexico.

Research Plan (1000 words maximum): *We recognize that this plan may be subject to change, but, we encourage you to be as specific as possible, please note any special materials and/or equipment needed for research as well.*

Week #	Work Subject	Summary	Materials needed
Week 1	The half of the first week will be used for university orientations, laboratory, mainly staff presentations. The other half of the week will be for the physical examination of the university departments that have the infrastructure, databases, software, etc. It will begin with the identification of research on the innovations that will support the study	Recognition of the university infrastructure, international agricultural trade information platforms, areas and departments that facilitate the exchange of experiences to enhance the research study.	Laptop Memory Stick Databases Internet
Week 2	Identification of the fundamental factors and elements of international trade Mexico - United States. That is, the institutional context in which the agri-food trade policy is sustained will be developed to establish the bases of analysis in the research.	Establish a reference framework on the normative, economic and cultural characteristics of international trade.	Databases National regulations Strategic study documents Article´s review
Week 3	Recognition and learning of the national agricultural policy in United States, its linkages in the different value systems. Training opportunities in the fields of agricultural policy and research and its link with Mexico.	Comparative analysis study on commercial agricultural policy between United States - Mexico	Databases National regulations Strategic study documents Article´s review
Week 4	Exchange of experiences between researchers and key actors in the field of commodities trade in the United States in order to understand exposure to perspectives and new technologies that can be applied in USDA.	Identify opportunities for facilitating international trade in Mexico in the field of commodities, fruit and vegetable products, and derivatives for the consumer and industrial sectors.	Work meetings with specialists Databases

Week 5	Learn the main methodologies used to identify agricultural and agro-industrial international trade costs, what are the opportunities and obstacles for the adoption of technology, such as ineffective policies and regulations in the face of new scenarios that arise in the world economy.	Document that will integrate the main methodologies used to identify agricultural and agro-industrial international trade costs, opportunities for the adoption of technology, agricultural commercial policies and regulations between Mexico - United States.	Work meetings with specialists Databases
Week 6	Identify the main technological tools, scientific innovations that strengthen agricultural practices, link between academia and government, that facilitate interactions to increase the competitiveness (international trade agricultural sector).	Document that shows the main technological tools, scientific innovations that strengthen agricultural practices, links between the academy-government company, and that facilitate interactions to increase the competitiveness of the sector.	Work meetings with specialists Databases
Week 7 – 8	Prospecting activities will be carried out during weeks seven and eight, with key actors and participants, to identify the main Technical Barriers to Trade (TBT) - Agriculture between both countries, and with this, propose alternatives that help improve trade.	Prospecting study to identify the main Technical Barriers to Trade (TBT) - Agriculture between both countries.	Work meetings with specialists Databases
Week 9 - 10	During weeks nine and ten, the qualitative and quantitative information obtained from the prospecting workshops on the main Technical Barriers to Trade (TBT) - Agriculture between both countries will be analyzed. With this, the routes to be followed to facilitate trade would be established, mainly for small producers in Mexico, and to establish strategies that facilitate interactions, knowledge and commercial exchange.	Strategic document based on the prospecting workshops on the main Technical Barriers to Trade (TBT) - Agriculture between both countries.	Work meetings with specialists Databases

Week 11	Compilation of the works, studies, analysis and databases developed in the previous weeks in order to generate a strategic document aimed at fulfilling the objective of my research.	Strategic document on the opportunities that Mexico has to adopt transfer of innovation structures to develop specific information in order to facilitate data sets, analysis, spatial mapping, science and information on trade in grains and agro-products, etc. between Mexico and the United States.	Databases Software Stata
Week 12	Develop a workshop with different actors and people who participated in the development of the research in order to exchange experiences, strengthen the knowledge learned and create collaborative networks for future participation between both institutions.	Final document that integrates the exchange of experiences, consolidate the knowledge learned and create collaborative networks for future participation between both institutions. Identifying the new opportunities to transfer about structures of innovations for develop specific information in order to facilitate the datasets, analyzes, spatial mapping, science and information on trade in grains and agro-products, etc.	Databases Software Stata

Borlaug Fellowship Program – Mexico – Increase the Antioxidant Compounds on Tomato Plants by Using Abiotic Stress – Fellow #4

Scope of Work
Fellow #4: Mexico, Male, Researcher Professor, Benemérita Universidad Autónoma de Puebla/Faculta de Ciencias Químicas/Department of Biochemistry and Food Science, PhD, Food Science

Goal
The goal of the fellow's research is to developed methodology applying UV and/or visible lights as abiotic stress in tomato plants to increase the bioactive compound synthesis (carotenoids, flavonoids and phenolic acids) with antioxidant capacity.

Fellow's Learning Objectives
- Use of abiotic stress for increasing the bioactive compounds with antioxidant capacity on tomato plants
- Evaluate the effect of UV and/or visible light to increase the bioactive compounds of tomato plants for further application as a heavy metal chelator.

Research Background

Tomato (Solanum lycopersicum) is the second most important vegetable crop worldwide with a global production of approximately 170 million tons. Mexico is the main exporter worldwide, and in the last years (2013-2016), an increase of 54.25% in tomato production was reported. However, in both greenhouse and open-air tomato production heavy metals have been found, and according to current reports, the heavy metal concentrations in plants have been increasing in an alarming way. Thus, it is necessary to investigate and apply different methodologies to consume vegetable products free from heavy metals. In this aspect, UV and some visible lights have been frequently used as abiotic stress to increase the synthesis of bioactive compounds of plants, including phenolic compounds, which have proven to be capable of chelating heavy metals due to their capacity to be a good donor of electrons. This project aims to evaluate the effect of UV and/or visible light for increasing the bioactive compounds of tomato plants for further application as a heavy metal chelator.

In Mexico, different studies have been carried out to find the effect of different industries on the heavy metal concentration in soils used for agriculture. In all of these works, heavy metal concentrations were out of the limits permitted by the normativity (Santos-Jallath et al., 2012; Castresana et al., 2019; Zanor et al., 2019). In this sense, the higher heavy metals pollution is in plant roots; however, in many cases, the aerials parts of them also present a high concentration of these compounds (Murtic et al. 2018). Therefore, it is necessary to find ways to reduce heavy metal intake due to agriculture products. Heavy metals present in agriculture soils are capable to inhibit the growth of plants, reduce the photosynthesis process, water balance, nutrient intake, and produce protein degradation, which causes the breakdown of cells, conducting to the plant death (Chen et al., 2019). However, under some concentration of heavy metals, phenolic compounds (phenolic acids and flavonoids) and antioxidant enzymes of plants are increased as a response against oxidative stress caused by heavy metals (Suárez et al., 2017), consequently, they are reduced due to the capacity of phenolic compounds for chelating them (Manquián-Cerda et al., 2018). In this sense, different studies have been conducted to evaluate the effect of phenolic compounds response against the stress produced by heavy metals (Kováčik et al., 2009; Manquián- Cerda et al., 2016). For example, (Li et al., 2016) evaluated the effect of phenolic compounds addition [catechin: gallic acid (1:2)] on cadmium added in mangrove plants. The results indicate that mangrove plants added with phenolic compounds showed the lowest concentration of cadmium in evaluated parts.

On the other hand, ultraviolet light (UV) has been currently used for inactivating microorganisms in foods or for inducing the synthesis of secondary metabolites as abiotic stress. Moreover, although visible light has been less studied, it is capable to increase the antioxidant compounds in plants due to its cryptochromes stimulation (Ávila-Sosa et al., 2017; Pérez-Ambrocio et al., 2018). In this sense, the light photoreceptors of the plants are important modulators of the growth and development of the plants, which affect them in several ways; for example: 1) the expression of several genes which are involved in the expression of secondary metabolites, 2) the activation of enzymes such as phenylalanine ammonia-lyase, chalcone synthase, and anthocyanin synthase, which are related to the biosynthetic pathways of secondary metabolite production, and 3) the reactive oxygen species (superoxide, hydroxyl, and alkoxy radicals, and hydrogen peroxide, among others), which increases the antioxidant enzyme productions such as superoxide dismutase, catalase, glutathione reductase, etc. (Pérez-Ambrocio et al., 2018).

The tomato cultivation has been increasing due to its higher demand by the consumers (Agroalimentario and FIRA, 2017). China is the largest consumer and producer of tomatoes worldwide; while the USA and Mexico are the main importer and exporter of the fruit, respectively (Agroalimentario and FIRA, 2017). In Mexico, the production of tomato has increased at 4.8 % per year, with 3.3 million tons in the last year (Agroalimentario and FIRA, 2017). In the same way, protected agriculture has increased from 1,078 in 2006 to 15,006 hectares in 2016. However, the tomato fruit as several crops worldwide is affected by heavy metal pollution, which may affect the aerial parts of the plants and be taken by the humans and animals causing several intoxications, mentioned before.

Expected Accomplishments

- Increase knowledge about light irradiance response of tomato plants.
- Develop a possible mechanism to reduce heavy metal concentration on tomato fruit for the publication of a research paper.
- Exchange knowledge between colleagues from México and the USA.
- Make a collaboration network between researchers from BUAP and some universities or research centers in the USA.

Contributions to Mexican Agriculture Sector

This Fellowship may contribute to increasing agriculture safety due to as I mentioned above, the heavy metal concentration in fruit and vegetables have been increasing in current years.
Therefore, to study and find a way to reduce or chelate heavy metal is a necessity.

Research Plan (1000 words maximum): *We recognize that this plan may be subject to change, but, we encourage you to be as specific as possible, please note any special materials and/or equipment needed for research as well.*

Week number	Summary	Material needed
1	Made a bibliography consultant about the tomato seed able to be used in this study. Select the material and condition to be used for growing the tomato plant. Select according to references the light irradiation source and doses which may stimulate the bioactive compound synthesis on tomato plants.	Computer and internet access. Material related to the tomato crop cultivation (soil, sand, water, fertilizers, etc.)

2	Place the tomato seed on trays for obtaining the geminate plant	Trays Cultivation tools Greenhouse
3	Irradiate the tomato plants under selected UV/Visible lights at determined doses. The treatments will be procured for 6-7 weeks Improve the methodologies to be used. Total carotenoids Total flavonoids Total phenolic compounds DPPH and FRAP assays for antioxidant quantification	Ultraviolet lamps (B or C lamps) Visible light (Red or blue light) Radiometer Spectrophotometer UV/Vis Centrifuge Vortex Micropipettes Gallic acid Ascorbic acid Folin-Ciocalteu reagent Trolox DPPH radical AlCl NaOH Na2CO3
4	Irradiate the tomato plants under selected UV/Visible lights at determined doses. The treatments will be procured for 6-7 weeks Improve the methodologies to be used. Total carotenoids Total flavonoids Total phenolic compounds	Ultraviolet lamps (B or C lamps) Visible light (Red or blue light) Radiometer Spectrophotometer UV/Vis Centrifuge Vortex Micropipettes Gallic acid
5	DPPH and FRAP assays for antioxidant quantification Irradiate the tomato plants under selected UV/Visible lights at determined doses. The treatments will be procured for 6-7 weeks Improve the methodologies to be used. Total carotenoids Total flavonoids Total phenolic compounds DPPH and FRAP assays for antioxidant quantification	Ascorbic acid Folin-Ciocalteu reagent Trolox DPPH radical AlCl NaOH Na2CO3 Ultraviolet lamps (B or C lamps) Visible light (Red or blue light) Radiometer Spectrophotometer UV/Vis Centrifuge Vortex Micropipettes Gallic acid Ascorbic acid Folin-Ciocalteu reagent Trolox DPPH radical AlCl NaOH Na2CO3
6	Irradiate the tomato plants under selected UV/Visible lights at determined doses. The treatments will be procured for 6-7 weeks Improve the methodologies to be used. Total carotenoids Total flavonoids Total phenolic compounds DPPH and FRAP assays for antioxidant quantification	Ultraviolet lamps (B or C lamps) Visible light (Red or blue light) Radiometer Spectrophotometer UV/Vis Centrifuge Vortex Micropipettes Gallic acid Ascorbic acid Folin-Ciocalteu reagent Trolox DPPH radical AlCl NaOH Na2CO3

7	Irradiate the tomato plants under selected UV/Visible lights at determined doses. The treatments will be procured for 6-7 weeks Improve the methodologies to be used. Total carotenoids Total flavonoids Total phenolic compounds DPPH and FRAP assays for antioxidant quantification	Ultraviolet lamps (B or C lamps) Visible light (Red or blue light) Radiometer Spectrophotometer UV/Vis Centrifuge
8	Irradiate the tomato plants under selected UV/Visible lights at determined doses. The treatments will be procured for 6-7 weeks Improve the methodologies to be used. Total carotenoids Total flavonoids Total phenolic compounds DPPH and FRAP assays for antioxidant quantification	Vortex Micropipettes Gallic acid Ascorbic acid Folin-Ciocalteu reagent Trolox DPPH radical AlCl NaOH Na2CO3 Ultraviolet lamps (B or C lamps) Visible light (Red or blue light) Radiometer Spectrophotometer UV/Vis Centrifuge Vortex Micropipettes Gallic acid Ascorbic acid Folin-Ciocalteu reagent Trolox DPPH radical AlCl NaOH Na2CO3
9	Irradiate the tomato plants under selected UV/Visible lights at determined doses. The treatments will be procured for 6-7 weeks Improve the methodologies to be used. Total carotenoids Total flavonoids Total phenolic compounds DPPH and FRAP assays for antioxidant quantification	Ultraviolet lamps (B or C lamps) Visible light (Red or blue light) Radiometer Spectrophotometer UV/Vis Centrifuge Vortex Micropipettes Gallic acid Ascorbic acid Folin-Ciocalteu reagent Trolox DPPH radical AlCl NaOH Na2CO3
10	At this stage, although tomato plant does not have fruits, it is able to be harvested for its roots, stems and leaves analysis.	Lyophilization equipment Glass bottles
11	Analysis of ethanolic extracts obtained from different parts of tomato plants. Optimization process based on the highest responses of antioxidant compounds tested.	Equipment and materials reported in week 3-8
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Borlaug Fellowship Program – Mexico – Certified Biofertilizers Based on Arbuscular Mycorrhizal Fungi – Fellow #5

Scope of Work
Fellow #5: Mexico, Male, Professor, Universidad Veracruzana/ Faculty of agricultural Science, MsC, Agriculture

Goal

The goal of the fellow's research is to promote the use of certified mycorrhizal biofertilizers, by developing a certification method.

Fellow's Learning Objectives

- Goal to be achieved by using molecular methods; such as next generation sequencing, to identify the microbial strains; efficiency test, based not only on the effect on yield but in product quality (metabolic analysis); consortia test, where not only one microorganism is used, but a consortia is evaluated while interacting with the plant.
- Selection of efficient mycorrhizal strains to be used as biofertilizers.
- Through the selection of efficient strains, generate a consortium of the selected strains that will give an advantage and added value to the product.
- Test the selected strains of MF and their combination in one model plant to observe, not only their effect in yield, but the quality of the final plant product.

Research Background

The new challenges of the development of agriculture rely on sustainability. Functional microbial biofertilizers have been used for more than 30 years in small and large farms.
These microorganisms are capable of fixing nitrogen biologically, promote plant growth, solubilize, and translocate main nutrients such as phosphorus. Arbuscular mycorrhizal fungi are among this biofertilizers that increase the absorption of phosphorus from the soil.

In Mexico there are commercially available mycorrhizal products that are sold under little or no regulation. Some of these products are locally produced, but other come from countries that do not comply with minimum quality requirements that EU or USA have. One of the main concerns regarding the use of marketed biofertilizer products is the consistency on results, certification, contamination-free and viability of what it is labeled in the product.

For the last 8 years I have been working with the implementation of arbuscular mycorrhizal fungi, nitrogen fixing rhizobacteria and phosphorus solubilizer fungi in the field. I have been focused not only in yield increase in the plant, but in the effect of this biofertilizers on plant protection against pathogens, but in their phytochemistry, as plant respond to biofertilization by changing their secondary metabolites production (vitamins, antioxidants, phenolics).

I have been comparing the use of single vs multiple species mycorrhizal fungi biofertilizers, where the correct combination of different strains favors the inoculated plant. In most experiments the correct combination of mycorrhizal species, can have the greatest effect on the targeted plant, whereas the use of single species or a less efficient combination of species, can´t reach the plant full potential yield.

The quality of the harvested product is also relevant, the effect of the inoculation of biofertilizers also changes the phytochemistry of the plant. It can increase antioxidant content that help the plant resist pathogen attacks, but can also affect the nutritional value, as biofertilizers can increase vitamins, sugars, and oil content in the final product.

With the aid of new molecular technologies and bioinformatics, we can now identify an mycorrhizal species and compare its genome with a data base. The information obtained can be used to understand the basic differences among mycorrhizal species than can save time when developing a biofertilizer. These genetic differences can help me design a biofertilizer in silico before testing it into the field or in a plant. Certain mycorrhizal species might have more gene copies for phosphorus transport, while others might contain genes that induce a systemic plant protection response in the plant.

This method will increase confidence in the developing of new biofertilizers with the goal of establishing a standard protocol for developing new products.

Expected Accomplishments

- During the fellowship I hope to gain knowledge on new molecular and analytical techniques that aid in the development of a pipeline to produce certified mycorrhizal biofertilizers.
- I have been involved in biofertilizer research since the beginning of my academic formation, so many of the benefits of this technology has not been implemented. By working together with more experience scientist, the implementation of this technology might be more available to local farmers and the local market.
- Most of the newly scientific published information is generated, not only in countries with a larger budget in science, but where the scientist can apply this knowledge. American scientist has the benefit of testing their research readily, and therefore, advance in their field. I had experienced this when I did my Masters in Denmark, as much of the integrated pest management strategies developed in their research institutes, are now part of the agricultural policy.

Contributions to Mexican Agriculture Sector

In recent years, the use of biofertilizers in Mexico has increased in popularity, as many products are new, only a handful of register companies exist in the country. Most of the products sold are wrongly labeled, packaged, contain only one cosmopolite strain, contain misleading information, or come from countries with different regulations regarding biofertilizers. This portrait a challenge, not only for the biofertilizer industry, but the phytosecurity as non-certified biofertilizer products, could potentially contain pathogens, pathogenic strains, or other competing non-target microorganisms. This is why it is so important to have a protocol to ensure that a biofertilizer contain tested and certified microbial strains.

Research Plan (1000 words maximum): *We recognize that this plan may be subject to change, but, we encourage you to be as specific as possible, please note any special materials and/or equipment needed for research as well.*

Week #	Work Subject	Summary	Materials needed
Week 1	Introductory Week Work with Mentor in developing applicable areas of Research Proposal	Plan the availability of lab equipment	Determine Lab Equipment needed

Week 2	Pure mycorrhizal species pots	The first step in the project is to establish pure mycorrhizal species cultures in pots	Quartz sand pots greenhouse
Week 3	Establishment of Test Pots	Corn as model plant will be used to select fungal strains based on, drought, salinity and biotic stress	Greenhouse pots Strain of Rhizoctonia solani
Week 4	DNA Extraction protocols	Extract DNA from single spores	Fungal DNA extraction/ isolation kit PCR kit Fungal primers (ITS1F-ITS4
Week 5	Fungal DNA Sequencing	At the time the mycorrhizal cultures are grown, morphotypes will be sequenced to identify the fungal species.	Access to Illumina sequencing or oxford nanopore sequencing
Week 6	Protocol for assessing vitamin content in plant	Standardized the method for measuring Vitamin B2,B9 and thiamine in maize (whole plant and grain)	HPLC with DAD/ electrochemical detector Phosphate buffer Folic acid standard Riboflavin standard Thiamine standard Millipore filters
Week 7	Harvest of pure culture pots	5 weeks after establishing pure culture traps for mycorrhizal fungi, the pure culture will be harvested, and the purity tested by PCR	PCR kit ITS1F-ITS4 primers metal sieves 38, 45, or 53 μm
Week 8	Asses growth variables in plant and mycorrhizal colonization from test pots and select the combination of mycorrhizal species combination. Evaluate mycorrhizal combination according to these results	The tests pots will be harvested to asses plant growth and vitamin content in leaf	HPLC with DAD/electrochemical Detector
Week 9 -10	Vitamin measurement of sample	The collected samples will be measure either by HPLC DAD, HPLC-Fluorescence, or Microbiologically (Lactobacillus casei Rhamnosus)	
Week 11 -12	Sample Evaluation	All the data will be evaluated to assess the results	Computer - Data Analysis