World Vegetable Center

World Vegetable Center (WorldVeg)
Terms of Reference (TOR) Consultancy

1. CONSULTANCY SUMMARY

Title: Phenotyping Okra Root Traits under Water Deficit Conditions

Consultancy Type: Non-consulting services

Division: WCA-CH

Duty Station: Home-based

Reporting to: Associate Scientist – Vegetable Breeder Dr. Mathieu Ayenan

Duration: from 1-Sep-2025 until 30-Apr-2026

Expected Deliverables: A final report and experimental data (raw and processed)

2. INTRODUCTION AND BACKGROUND

Okra (Abelmoschus spp.) is a culturally significant and nutritionally rich vegetable crop. It plays an essential role in traditional diets across many parts of the world, particularly in Africa and Asia. The crop is valued for its resilience, high nutritional content, and potential to improve food security and income for smallholder farmers.

In Africa, okra is mainly grown under rainfed conditions and often faces dry spells during the growing season. Understanding how the crop responds to water deficit will help develop climate-resilient varieties. The root system of okra, similar to that of many other crops, is crucial for accessing water and nutrients during unfavorable conditions. However, root traits are still not well understood in most breeding programs due to technical challenges involved in studying underground features.

To address this, the World Vegetable Center (WorldVeg) aims to incorporate advanced root phenotyping techniques into okra breeding projects focused on drought tolerance. This research aims to examine the variability in root system architecture (RSA) among 20 genetically diverse okra genotypes under both optimal and water-limited conditions. Water deficit will be imposed during the reproductive stage—recognized as the most vulnerable period for yield reduction—to identify genotypes possessing root traits linked with superior performance during water scarcity

3. OBJECTIVES OF THE CONSULTANCY AND EXPECTED RESULTS

The overall goal of this experiment is to support drought-resilient okra breeding by integrating high-resolution root phenotyping into the evaluation of diverse genotypes.

Specific objectives are to:

- Identify variability in RSA traits among 20 genetically diverse okra genotypes under both well-watered and water-deficient conditions.

- Characterize root traits associated with drought tolerance, including root depth, total root length, root volume, lateral root density, and branching angles.
- Compare genotype performance under stress and non-stress conditions to identify root phenotypes linked to improved water-use efficiency and plant resilience.
- Generate a trait-based dataset to support the selection of candidate genotypes for future breeding efforts focused on drought adaptation.

4. DESCRIPTION OF THE ACTIVITIES BY THE CONSULTANT

The Consultant will:

- Work closely with WorldVeg scientists to refine the study plan.
- Obtain necessary documentation to initiate and accomplish the seed shipping.
- Perform root phenotyping on 8 biological replications of 20 okra genotypes grown in pots on well-characterized soil medium under 2 treatments (water deficit and well watered control) using root scanning combined with artificial intelligence-supported image processing according to the agreed study plan.
- Grow the experimental plants in a greenhouse/growth chamber and induce water deficit by withholding irrigation (15 days) for the treatment group once plants reach the reproductive stage. Control plants will continue to receive regular watering.
- Harvest plants at the end of the stress period for root scanning.
- Collect data on shoot biomass, stem diameter, and RSA (median and maximum number of roots; number of roots; number of root tips; total root length; lateral root density; depth, maximum width, and width-to-depth ratio; average diameter, perimeter, volume, and surface area of the root system; average root orientation, shallow, medium, steep angle frequencies; fine, medium, coarse diameter frequencies of the root diameter, root system network area; root systems convex hull) on 160 (8 replications x 20 okra genotypes) well-watered plants and 160 (8 replications x 20 okra genotypes) water-stress plants.
- Share soft copy of collected data (pictures of root scans) and processed data with WorldVeg scientists online.
- Provide temperature and humidity data during the experiment.
- Participate in monthly online meetings with WorldVeg scientists. The date and time of the meetings will be provided by WorldVeg.

5. WORLDVEG'S RESPONSIBILITIES

WorldVeg will:

- Provide the genetic material (seeds of 20 okra accessions) and ship the okra seeds to the Consultant.
- Provide agronomic expertise to grow okra.
- Contribute to the finalization of the study plan.

- Conduct monthly meetings to discuss the progress of the experiment.
- Guide and supervise the consultancy.

6. PAYMENT MODALITY

Deliverable based. No reimbursement costs are provided under this consultancy.

7. DELIVERABLES AND CONCRETE TIMELINES

Please be as specific as possible. This is important especially when the consultant is to be paid on the basis of deliverables as this may avoid misunderstandings during contract execution.

No	Deliverable / Expected output	Due by
1.	A refined study plan and study design	19-Sep-2025
2.	A final Study Report on the experiment • Should provide a compilation of experimental data on 320 plants of the 20 genotypes (quantitative root systems architecture data and images of root scans, weather data during the experiment), plus a statistical analysis of the results, into a comprehensive final report. • Should include detailed information on the methodology and key findings to guide future breeding efforts.	30-Apr-2026

8. FACILITIES AND SUPPORT PROVIDED BY WORLDVEG

N/A

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World Vegetable Center (WorldVeg)
Request for Bids (RFB)

General Information

1. Procurement Requisition No.: 1072500
2. Procurement Title: Phenotyping Okra Root Traits under Water Deficit Conditions
3. Procurement type:

   ☐ Goods ☐ Works ■ Non-consulting services ☐ Consulting services-firm
   ☐ Consulting services-individual
4. Specifications or Terms of Reference (TOR): Please refer to PR1072500 TOR.

Procurement Method and Evaluation

5. This contract will be awarded based on the total price in USD.
6. The procurement process will follow the procedure:

   ☐ Direct Contracting ☐ Limited Biding ■ Open bidding
7. The procurement will be evaluated based on:

   ☐ Cost ☐ Quality ■ Cost and Quality
8. Bid Evaluation Methodology:
   a. Technical criteria (70%)
      i. (40%) Technical proposal showing the ability to apply root scanning and artificial intelligence-supported image analysis to determine root phenotypes on horticultural plants within the required timeframe and a qualified team.
      ii. (20%) Past performances and positive references to similar activities of root phenotyping of horticultural plants.
      iii. (10%) Qualifications of team members.
   b. Financial criteria (30%): Total cost comparison per WorldVeg Procurement Regulations.
9. Where necessary, shortlisted bidders may be invited for an interview, the details of which—such as time, date, venue, and format—will be separately communicated by WorldVeg.

Bidder Requirements and Documentation

10. Bidders must meet the following eligibility criteria:
    a. Demonstrate proven expertise and possess appropriate facilities for conducting root system architecture (RSA) phenotyping in horticultural crops, including the capability to evaluate key root traits under controlled or field conditions.

b. Be legally authorized and operationally capable of processing international seed import documentation and receiving okra (*Abelmoschus esculentus*) seeds from the Republic of Benin, in compliance with all relevant phytosanitary and customs regulations.

11. Bidders must submit the following documents in **separate pdf files**:
    a. **A Technical Proposal** outlining the proposed study design and implementation plan, including:
        i. A detailed methodology for root system architecture phenotyping.
        ii. A timeline of activities.
        iii. Documentation of relevant past performance, particularly in similar horticultural research or field studies.
        iv. An overview of the proposed team structure, including roles, responsibilities, and qualifications of key personnel.
    b. **Legal and Certification Documents**: Copies of valid and up-to-date firm registration certificates, business licenses, import permit, and any other relevant certifications verifying the legal status and professional credibility.
    c. **A Financial Proposal** outlining all anticipated costs and expenses.
12. Bidding documents must be in English.
13. Where required, WorldVeg may request bidders to provide the original qualification documents for verification.

Bid Opening Process

14. The bid opening will follow a one-step process. All bidding documents must be securely sealed in a single email or envelope as required.
15. Where necessary, bidders may be invited to attend the bid opening at the time, date, and venue specified separately by WorldVeg.
16. Bids must remain valid for ☐ 60 days ■ 90 days ☐ 120 days from bid opening date until the evaluation recommendation is approved. If the procurement is not awarded within this period, WorldVeg may request an extension of the validity period.

Communication and Submission

17. Any inquiries regarding this tender should be directed via email to WorldVeg HQ Procurement office at purchasing@worldveg.org before **18-Aug-2025.**
18. All bids must be submitted with the subject line "**PR1072500 – Phenotyping Okra Root Traits under Water Deficit Conditions**" by 4:45 PM (Taipei time) on **25-Aug-2025** to WorldVeg HQ Procurement office at purchasing@worldveg.org.

Compliance and Restrictions

19. This procurement does not allow joint or cover bidding.
20. All WorldVeg procurements adhere to public procurement principles. Any procurement-related complaints should be submitted in accordance with the procedures outlined on the WorldVeg website.