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One Health Implications of a

Novel *Bacillus subtilis* Bioinoculant

for Agricultural Yield Improvement

Strain B3VCR2 · From traditional fermented food to field-scale biocontrol
across 6 countries in Africa

Burkina Faso

Senegal

Nigeria

Morocco

Benin

Ghana



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UNIVERSITY OF LEEDS

Peri-urban farmers across Africa face converging threats:

Rising temperatures and erratic rainfall are pushing crops to their limits, while pest outbreaks are intensifying and spreading faster than ever before.

Chemical pesticides and synthetic fertilizers offer short-term relief but carry long-term costs to soil health, human wellbeing, and ecosystem stability.

Climate change is accelerating fall armyworm from 4 → 6–8 generations per year

20–50%

crop yield lost to fall armyworm alone

30%

grain weight lost to storage pests in rainy season

46 °C

peak temperatures recorded in Morocco & Senegal

From Traditional Food to Modern Science

Isolated from **fermented locust beans (dawadawa)** — a traditional food in Burkina Faso. This single bacterium carries a remarkable genetic repertoire:

- ✓ Stimulates root growth (auxin hormones)
- ✓ Suppresses harmful fungi naturally
- ✓ Solubilizes phosphorus for plant uptake
- ✓ Withstands heat, drought & salt
- ✓ Produces 7 types of natural antibiotics

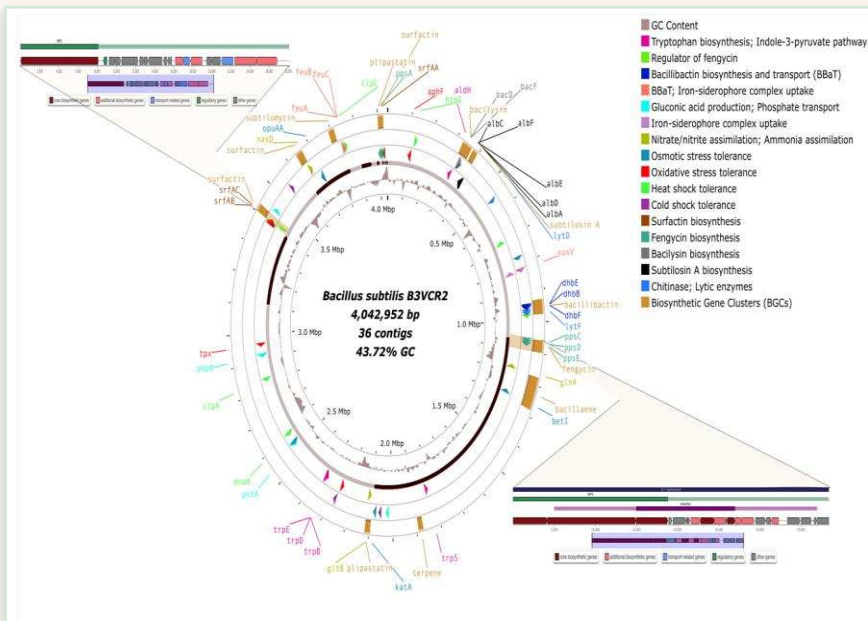


Fig. Circular genome map of *Bacillus subtilis* B3VCR2 showing annotated biosynthetic gene clusters

4.04 Mb

Genome

99.6%

Complete

14

BGCs

7

Pathways

THE URBANE NETWORK

6 countries · 2 farm sites each · 18 months of monitoring

Burkina Faso

Strain origin site · Probiotic & crop trials

Senegal

Poultry & tomato synbiotic trials

Nigeria

Crop monitoring · 42 rainless days (2023)

Morocco

Climate-stressed trials · 46 °C peak heat

Benin

Metagenomics deep-dive · 2 contrasting sites

Ghana

Policy analysis & stakeholder engagement

Agricultural Trials

Synbiotics applied to chickens & tomato plants

Soil Metagenomics

Shotgun metagenomic sequencing every 6 months

Climate & Pest Data

IoT sensors + sticky trap image analysis

Baseline sampling at T0 · repeat monitoring every 6 months at 2 farm sites per country

POULTRY — Probiotic Trials

Better Feed Conversion

Chickens receiving B3VCR2 synbiotic grew more efficiently — producing more body mass per unit of feed consumed

Lower Mortality Rates

Treated flocks showed measurably reduced death rates compared to controls in multiple trial sites

Gut Microbiome Benefits

Probiotic treatment positively modulated gut microbiota, consistent with improved animal health outcomes

TOMATO — Synbiotic Trials

Encouraging Growth Patterns

Plants treated with synbiotic formulations showed positive growth responses including better root development and plant vigour

Fungal Suppression Activity

B3VCR2 produces fengycin and surfactin compounds that actively inhibit harmful soil fungi threatening root systems

Phosphorus Availability ↑

The bacterium solubilizes bound phosphorus in soil, making this key nutrient available even in nutrient-poor conditions

ONE HEALTH MONITORING

Connecting soil · plants · animals · people

Metagenomics

Who lives in the soil?

- Shotgun DNA sequencing for all types of microbes including bacteria & fungi
- Sampled at baseline (T0) + every 6 months
- Detects AMR genes and pathogens
- 2 farm sites per country

Climate Data

What are crops enduring?

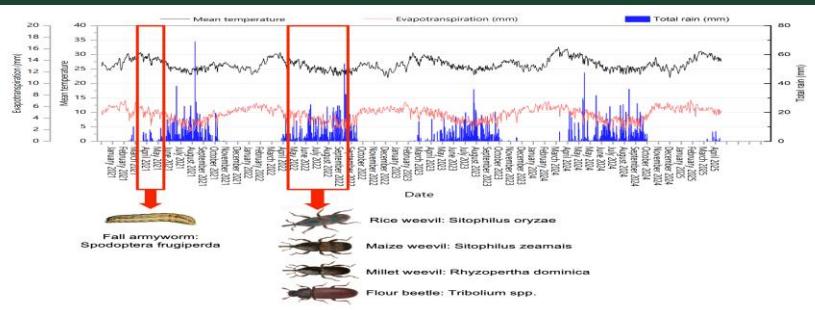
- IoT SenseCap weather stations at each site
- Temperature, humidity & rainfall logged
- 46 °C peaks · 42-day dry spells recorded
- Links climate stress to pest outbreaks

Pest Surveillance

What's attacking the harvest?

- Sticky trap networks across all 6 countries
- AI image analysis identifies pest species
- Fall armyworm, weevils & locusts tracked
- Seasonal outbreak patterns documented

REAL DATA: Climate & Pest Monitoring Time Series (representative site, 2021–2025)



Integrated surveillance revealing the invisible connections between microbial life, environment & human health

WHAT THE DATA REVEALED, BENIN CASE STUDY

Two farms, two very different stories

Akassato, Benin — Resilient Soil

Stable, abundant beneficial bacteria throughout monitoring

Natural increase in nitrogen-fixing Mesorhizobium bacteria

Healthy ecosystem showing natural resilience

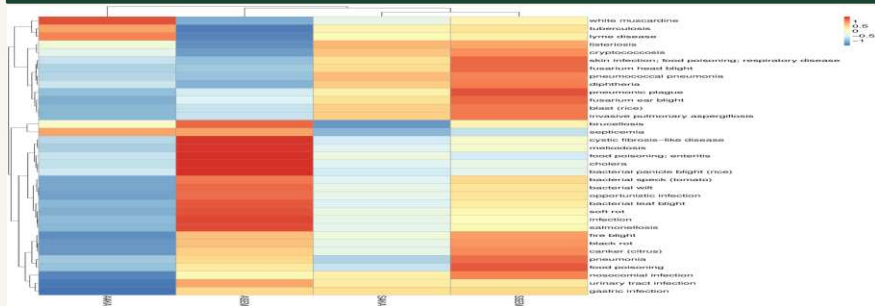
Seme-Kpodji, Benin — Soil Under Stress

Beneficial mycorrhizal fungi collapsed — plants losing nutrient access

Harmful Fusarium fungi exploded to dominate the community

Salt-loving organisms appeared — possible salinization

METAGENOMICS FINDING: Disease & pathogen associations detected at Benin farm sites (AKAN=Akassato, SEMI=Seme-Kpodji)



!! ONE HEALTH ALERT

High antimicrobial resistance (AMR) genes detected across farm microbiomes
Pathogens identified in soil & water:

- *Mycobacterium tuberculosis*
- *Salmonella enterica*
- *Vibrio cholerae*
- *Ralstonia solanacearum*

These contrasts guide tailored interventions — healthy soils enhanced, stressed soils investigated

*B3VCR2 is more than a biofertilizer —
it is a window into the connections between
soil, plants, animals, and human health.*

01

Traditional fermented food harbours high-value microbes for sustainable agriculture

02

Probiotic application improved both livestock health and crop growth in early trials

03

Metagenomics revealed hidden soil health crises and bright spots that shape our strategy

04

One Health monitoring links environmental microbiome data to food safety, AMR & human wellbeing

Next steps: Confirm causal role of B3VCR2 via targeted tracking experiments · Scale successful interventions · Co-develop policy with farmers