Field Testing and Phenotyping for Breeding

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Introduction

Who are we?

• **Sanesh Ramburan (Phenotyping Lead Africa)**
  • Based in South Africa (Petit breeding station)
  • 20 years experience (Multi-environment trials, cropping systems research, commercial breeding, plant physiology, cultivar adoption, G x E).
  • Crop experience – Wheat, Barley, Oats, Sugarcane, Maize.
  • 3 years with Bayer (Legacy Monsanto)
  • Roles – Organization leadership, testing network design and management, operational management, analytics/systems/processes.

• **Jamlick Mwathi (Testing Lead – Sub-Saharan Africa)**
  • Based in Kenya (Nairobi)
  • 12 years of experience in breeding, multi-environment trials, project management.
  • Crop experience - Rice and Maize.
  • 9 years with Bayer/Legacy Monsanto.
  • Roles – Testing network management, resource optimization, team management.
Introduction

What will this seminar cover?

1. **Overview and fundamentals of field testing and phenotyping**
   - Field testing concepts, critical considerations for network design, organizational structures, and key disciplines within phenotyping.

2. **Field trial execution**
   - Site selection, land prep, planting, trial management, data collection, harvesting.

3. **Data quality management**
   - Tiers of data quality management, importance of managing spatial variation, automated QC.
Fundamentals of Field Testing and Phenotyping
The Product Testing Journey (The big picture!)

- **BREEDING**
  - Product Knowledge
  - Product Numbers
- **PRE-COMMERCIAL**
  - Product Knowledge
- **COMMERCIAL**
  - Environmental exposure
Optimized Field Testing Networks

- Farmer managed (aligned with target market)
- Representative of target environments
- Wide distribution (spread risk)
- Practical and accessible sites
- Collaborator/Contractor relationships critical
- Capture pest/disease variations
- Field uniformity

3 year average yields per location
- Sampling a wide range of yield potentials
Bayer Field Testing/Phenotyping Global Hubs

Autonomous organizations
Data ownership
Standardization
Modern Transdisciplinary Phenotyping
Field Trial Execution

Key concepts
Goal is to identify and eliminate all possible variables

Data looks good enough to me let’s go!

That was quick.
Uneven emergence
- poor seed to soil contact
- inadequate moisture
- Cloddy field conditions
- avoid taking certain notes

Sprayer tire track damage
- careless or inexperienced operator
- guess rows effect
- lack attention to detail
- difficult to quantify effects
**Guess Rows**

- Deactivate plots with guess rows +/- 15 cm variance
- May require several ranges to be deactivated
- Monitor this while planting
- Recalibrate/fix GPS immediately

**Gaps**

- Hand plant gaps before V2 stage
- Deactivate plots with gaps >1.2m
- Deactivate adjacent plot due to competition
Weed Control

- Poor weed control creates variability
- Late season weed control
  - Harvest issues
  - Accurate moisture readings
  - Questionable data
- Deactivate due to weed pressure
**Fertilizer deficiencies**

- Blockage or restricted knife on an anhydrous applicator
- Use only calibrated fertilizer equipment
- Ensure all monitoring equipment is working properly
- Possibly change fertilizer application technique to reduce potential variability

**Ponding**

- Intense rainfall, poorly drained soils
- Poor field selection
- Inspect fields during off season…
- Avoid mapping plots in these areas…use filler
Animal Damage

- Avoid plots near bushy areas
- Need to differentiate between animal damage and stalk lodging
- Take good notes and make sure QA/QC delegate is aware of situation

Nematode Damage

- sandy soils
- Stunted plants, damaged roots
- Variation across plots, reps & field
- Abandon by rep or entire location
Severe weather events
- determine value in taking field notes
- determine if field is harvestable
- could impact pollination
- only collect harvest traits

Soil variability
- site selection…
- use filler or better rep placement…
- Deactivate the plots
Data Quality Management
Different tiers of data quality management (Field Trials)

// Pre-planting
  // Entry verification
  // Trial packing
  // Trial scanning

// Planting
  // Skips/double
  // Alley alignment
  // Range shift/plot swap

// Early season trial management
  // Gap identification and plot deactivation
    // Establish rules and thresholds
    // Capture reasons for discarding plots
  // Neighboring plot effect
Different tiers of data quality management (Field Trials)

// Infield data collection (Protocol-related QC)
// Establish protocols that minimize data collection errors e.g. SOPs, training and verification

// Plot data collection (Digital tool QC)
// Numeric thresholds for traits – minimize finger errors

// Field-level QC
// Digital trial maps – identification of spatial trends
// UAV-collected traits
Different tiers of data quality management (Field Trials)

// Post-harvest multi-trait QC and outlier detection
// Are calculated traits calculating correctly?
// Network level visualization of trends
Other critical topics – to be covered in workshops

// Mechanization and automation

// Testing network optimization – G x E, location evaluation, network design

// Digital data collection – UAV workflows

// Weather/Soil/Management data – Metadata

// OR models and system efficiencies
Thank you!