CIAT
International Center for Tropical Agriculture
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BREEDING HIGHLIGHTS (ECABREN)

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BREEDING ACTIVITIES IN ECABREN REGION

- Reviewing the current and future risks to bean production and utilization associated with major environmental stresses and end user systems
  - Pest and Disease status (Identification and establishment of the distribution and occurrence of pests and diseases)
  - Identification of new sources of biotic and abiotic constraints
- Studying/validating the genetic and physiological mechanisms of resistance to different environmental stresses
- Development of new multiple stress resistant bean varieties
- Nutrition breeding : high Fe and Zn
- Niche market products- Canning beans and Runner beans, others?

IDENTIFICATION AND ESTABLISHMENT OF THE OCCURRENCE AND DISTRIBUTIONOF PESTS AND DISEASES

- Partial surveys in most of the ECABREN countries
- Preliminary results (examples):
  - BSM, and Aphids becoming more severe, on farm and on-station- Kenya, Uganda, Tanzania and Malawi
  - African bollworm (*Helicoverpa armigera*) and rust big threat to snap bean production in Kenya
  - Rust, common bacterial blight, Anthracnose, Angular leaf spot-Ethiopia, Tanzania, Uganda, Burundi, EDRC and WDRC
  - Sporadic occurrence of Halo blight and Aschochta blight, Anthracnose, Angular leaf spot
  - Bean root rot- Burundi at low altitude (700 to 1000 masl)
  - Cowpea mild mottle virus and Macrophomina root rot -Sudan,
- Diseased plant samples collected from some agro ecological zones
- Molecular characterization initiated in Uganda and Kenya,
- Phenotyping done in Kenya and started in Uganda.

IDENTIFICATION OF NEW SOURCES OF BIOTIC AND ABIOTIC CONSTRAINTS

- Several ECABREN countries started screening available germplasm (ALS, ANTH, Rust, CBB, BCMV)
- Land race collections/rejuvenation
- Use of disease differentials for anthracnose, angular leafspot and rust (Kenya, Uganda, Madagascar)
- Acidic soils –Madagascar
- Bean Stem Maggot- Kenya: Seven combined resistance to drought and BSM.
- Bruchids- Burundi, All varieties were susceptible to bruchids.
- Charcoal Rot (*Macrophomina phaseoli*)- Sudan, six varieties showing resistance

SCREENING FOR BSM TOLERANCE:

- Challenge for bean breeders working on insect resistance is the attainment of optimal pest pressure under field conditions to effectively screen genotypes for resistance

- For BSM: PABRA contracted work to develop a mass rearing technique (where?) Limited progress has been made in validating the mass rearing technique for bean stem maggot

- Studies of Pascal Okwiri indicated that delaying planting by two weeks at the onset of the cropping season can enhance BSM populations and reduce incidence of escapes.
  - The population dynamics of bean stem maggot is known to depend on the time of the season, and delayed planting results in build-up of *O. phaseoli*.

STUDYING/VALIDATING THE GENETIC AND PHYSIOLOGICAL MECHANISMS OF RESISTANCE TO DIFFERENT ENVIRONMENTAL STRESSES

- Biological Nitrogen fixation
- Heat and drought tolerance
- Low soil fertility tolerance
- Mechanisms of resistance
- Bruchids resistance
- Multiple disease resistance breeding-parents

NITROGEN FIXATION

- Work done in Kenya under N2Africa Project
- Over 1000 bean genotypes with and without rhizobia inoculation.
  - Test lines included advanced lines of diverse market classes, growth habit, tolerance to low soil fertility, drought, mineral density, and resistance to major biotic stresses
- A highly significant genotype x environment interaction was detected, indicating that nitrogen fixation varies with environments
- Mean number of nodules across sites varied from zero among the four non-nodulating lines to 31 nodules per plant
- More than 20 genotypes had over 90 nodules per plant
- Similar studies are planned in Uganda in the 2nd growing season of the year and all research materials have been received at NACRRI, Namulonge.

DEVELOPMENT OF FUSARIUM ROOT ROT RESISTANT LINES

- Stability in different genetic backgrounds of SSR marker PVBR87 spanning the QTL for FRR resistance, confirmed
- Populations segregating for resistance to Fusarium root rot advanced to F6
- Potential of using pyramided resistance genes in improving resistance to FRR in susceptible bean cultivars demonstrated
- Resistance to Fusarium root rot found to be independent of the major gene for *Pythium* resistance in RWR 719 ($\chi 2 = 4.96$, $P = 0.29$)
  - Marker-trait association analysis revealed that the *Pythium* SCAR marker PYAA19 was not associated with Fusarium root rot resistance in RWR 719 ($R2 = 0.005$, $P \leq 0.49$), but was strongly associated with *Pythium* resistance ($R2 = 0.77$, $P \leq 0.001$)

LOW SOIL FERTILITY TOLERANCE

- Revitalization of BILFA during PABRA forum
  - Include drought
  - Develop **new Bilfa nurseries**
  - Create a **mechanism for evaluating breeding material for resistance to edaphic stresses and drought**
- **BILFA 6-** 900 entries constituted (selections from Nutribean Nursery)BILFA 6.xlsx **BILFA 7** with 500 entries constituted (mainly from selections from genetically diverse regional drought nursery); Seed increase at Kabete and Thika **November 2010**
- **Climbing bean nursery** for adaptation to edaphic stresses and moisture stress **(BILFA 8)?**
- Breeding and selection for tolerance to
  - Acid soils, Al, Fe, Mn toxicity, Low soil macro elements(N,P, S, Ca, Mg, K), Low soil microelements (Zn, Mo & Se), Soil salinity
  - Soil degradation

DEVELOPMENT OF NEW MULTIPLE STRESS RESISTANT BEAN GERMPLASM

- All ECABREN Countries apart from Burundi, Madagascar* and Sudan

- Identification/selection and testing of new multiple stress resistant bean germplasm
- Development of new segregating populations for MCR (pests, diseases, drought and low soil fertility tolerance)
- Selections from segregating populations for MCR
- Yield trials at different stages
- Release of MCR varieties (PABRA report)

DEVELOPMENT OF MALE BREEDING PARENTS-MAS

- CIAT-Kawanda; ALS, Anthracnose, BCMV, Root rot: 62 F2 plants having two gene combinations for Pythium root rot and Angular leaf spot (*prr + Phg-2*) and two plants having four genes combined for BCMV and Anthracnose (*Co4, Co5, I, bc3*)

- NACRRI: Single crosses among eight parents to pyramid genes for resistance to ANTHG, ALS, BCMV, CBB, and BRR

- UoN: crosses were made include:
  - G2333/ G10909// AND 1062, G2333/G10909//RWR 719, G2333/Mex 54//AND 1062, (anthracnose, ALS and root rot). Others include G2333 x G10474 (and reciprocal), G2333 x Mex 54, RWR 719x BRB 189, G10909 x G2333, AND 1062 x BRB 189 and VAX 6/BRB 191. (Anth + ALS, RR + BCMV, CBB + RR)

- Tanzania (SUA): CBB, ALS, BCMV and Anth

DROUGHT TOLERANCE

- TLLII-Kenya, Ethiopia, Tanzania

- New Phase: Ethiopia, Tanzania and Uganda
- Next steps:
  - Advance elite material to AYT, NPT and release
  - New TL 2 phase will focus on dissemination of phase I materials
  - Continue selection from populations with multiple constraint resistance
  - Mechanism of drought resistance: focus on root traits, seed fill (remobilization) and earliness

- Bioinovate: Kenya, Ethiopia, Tanzania, Burundi and Rwanda

NUTRITION BREEDING

- **First generation** lines released or in pre-release stages (Rwanda, DRC, Kenya, ..)
  - Production of breeder and certified seed in progress in several countries
  - Dissemination initiated with a target of reaching > 1 million households by 2013
- **Second generation** lines: NUA, NUV and KAB distributed to several countries and are being evaluated and selected e.g., DRC, Rwanda, Kenya
- **Population development**: Objective is to **combine** high mineral trait, resistance to biotic and abiotic stresses, high yield potential and marketable grain types
  - Population development in DRC, Kenya, Rwanda,
- **Target** is 90 ppm Fe and >35 ppm Fe
- Nutrition Nursery-Rwanda Materials and DRC. Seed increaseNutrition Regional Nursery.docx

NICHE MARKET PRODUCTS

Snap Beans

- Major traits: pod shape, size, texture, rust, ALS & ANT
- **Populations** developed at Kabete in 2006 combining resistance to **rust, angular leafspot and anthracnose**
- Populations, advanced bush and climbing lines distributed to **7 countries** in ECABREN and WECABREN in 2010
- Screened for single and multiple resistance at Thika and Mwea under **artificial inoculation** and selections made
- Next Steps
  - PYT for advanced bush and climbing snap beans
  - Pedigree selection for F4, F5 and F6
  - Continue participatory selection for multiple resistance , pod quality and pod yield
  - May need technical backstopping

RUNNER BEANS

May have niche in cooler highlands where *P.vulgaris* performs poorly

Runner beans resistant to most bean diseases

Objective: develop short day grain type-for local consumption and snap for export

Population development:

- Populations of local short day x snap long day developed at Kabete
- Segregating populations advanced by bulk method to F_5 at Kabete and Laikipia

Selection

- Single plant selection made at Kabete, Ol Jorok and Laikipia
- Progeny rows established at Subukia and Ol Jorok and at Kabete
- Evaluation of progeny rows done
- Short day, snap will facilitate access by smallholder farmers who cannot afford extended lighting
- Next steps:SPS selection for pod quality (length, shape, texture) for snap types and grain yield for dry grain types and adaptation to short day conditions