Feature Stories

Farmers in East Africa on the move beyond subsistence farming

Mr Jackson Ramadhani in his farm in Nkungi Village, Iramba District, Tanzania.

Photo: C. Wangari, ICRISAT

From subsistence to commercial sorghum farming

“I was struggling to provide a livelihood for my family. But now I harvest more sorghum and finger millet for food and sell the excess to the market. From the sales proceeds, I get enough money to pay school fees for my two children. I have also built a modern house, bought a motorcycle, 12 cattle (among them 8 bulls) and started poultry keeping from the money I gained from selling sorghum and finger millet grain and value-added products (cakes and mandazi).” Juliana Gunzu.

Juliana Gunzu is one of 40,000 farmers who have benefited from the introduction of improved sorghum varieties and training on how to manage the crop in the field, how to handle the crop during and after harvesting and on agribusiness. Juliana comes from Iramba district in central Tanzania, which experiences low rainfall and short rainy seasons that are often erratic, with widespread drought in one year out of four.

5 years ago, Juliana was a poor farmer who produced very little from her farm. Today, she is what they call a QDS (Quality Declared Seed) farmer. Quality declared seed is a class of seeds which are produced by farmers at farmer/village level while following government rules and regulations and are sold in the community. She is also a lead farmer who offers extension services to other fellow farmers using the farmer field school approach.

She attributes her success to her involvement in the recently concluded IFAD project – Sorghum for Multiple Uses (SMU).
SMU began its operations in January 2011 and has just concluded in September 2017. The project has been very effective in improving food and nutritional security and incomes of the smallholder farmers in Kenya and Tanzania which were the countries of focus for this project.

Improved varieties of sorghum (Macia and Kari Mtama 1), finger millet (U15 and P224) and pearl millet (ICMV 221) were distributed to farmers through seed minipacks. These farmers were then trained on how to produce clean seed. In Kenya, the project used the informal seed delivery systems, while in Tanzania, they used QDS system to ensure supply of seed in the communities. This proved to be very successful. In 2016 and 2017, for example, farmers in Western Kenya produced 110 tons of sorghum and finger millet seed from the 28 tons of foundation seed multiplied at the research stations.

In addition to working to improve access to better seeds and increasing productivity, the project team worked to enhance utilization and commercialization of sorghum. The project purchased threshers which were used to ease the labor burden from especially women and children usually involved in the threshing, in addition to improving the grain quality which enabled the farmers to fetch higher prices. The project also purchased charcoal ovens which were used to train over 70 farmer groups on value addition of sorghum. Other farmers were trained on poultry feed formulations and on the utilization of sorghum stovers for livestock. Thus, there has been a spike in the demand and utilization of sorghum in these communities.

Success of collective marketing

Aspects of collective marketing were introduced and very well embraced by the farmers. Over 150 marketing groups were formed and their members trained on grain production, post-harvest handling and agribusiness. Being part of marketing groups helped to assure farmers of fair prices for their produce, on one hand and on the other, assuring buyers of high quality grain. Marketing groups tend to have stronger bargaining positions and have set up systems to maintain minimum quality requirements. This has been very fruitful particularly in Tharaka Nithi county in Kenya where over 1500 tons of sorghum worth Kshs. 54 Million ($540,000) was sold to the East Africa Malting Limited (EAML) in 2016.

Successes in this program has led to the birth of a new five-year program called SOMNI (Strengthening Sorghum and Millet Value Chains for Food, Nutritional and Income Security in Arid and Semi-Arid Lands of Kenya and Tanzania), which is designed to build on the successes of SMU.

"SOMNI will be working to promote sorghum, finger & pearl millet, pigeonpea and cowpeas. Combining smart cereals and legumes will achieve a triple win – improved nutrition, incomes and climate adaptability”, said project team leader, Dr. Henry Ojulong. “We need to further improve the utilization of these foods for better food and nutrition security”, he added.

Dr. Eric Manyasa, Sorghum Breeder at ICRISAT points out that SOMNI will build on successes of SMU and HOPE 1 which include, among others, the release of 11 sorghum varieties (6 Open Pollinated Varieties -OPVs and 5 hybrids) in Kenya and 2 sorghum OPVs in Tanzania. These varieties, he said, offer farmers a variety of choice based on what suits their agro-ecologies and end-use. SOMNI will be up and out scaling these technologies.

"It’s not enough to have nice varieties” says Dr. Michael Njuguna, Director Food and Nutritional Security Programmes, Africa Harvest. “Our focus in this project will be to deliver these varieties to the farmer"

SOMNI brings together a variety of partners including researchers, agriculture and nutrition extension personnel from the national programs, NGOs, private seed companies, food and feed products processors, among others.

“We and not I is a core message for this project. ICRISAT cannot work alone and partnerships of the NGOs, government agencies and the private sector are vital to reach our farmers in the arid areas”, said Dr. Esther Njuguna, an ICRISAT scientist specializing in gender integration.

The new project which covers Kenya and Tanzania seeks to improve the livelihoods of at least 30,000 resource constrained farmers and will have a special focus on the youth, women and the disadvantaged members of the farming communities.

To know more about ICRISAT’s work in seed systems, click here
Could restoring degraded lands cut down on labour migration in Niger?

Most Nigeriens depend on farming but widespread soil degradation and climate variability make it difficult to sustain a family all year long.

Every year, unwanted migration of millions of people fleeing hunger, poverty and conflict is transforming the international development agenda for the years to come. 244 million people, about half of whom are women, decided to migrate in 2015, hoping for a better future for their children. With climate change and widespread land degradation, environmental migration is on the rise.

This is particularly true for Niger a country of the Sahel region used to men migrating to neighboring countries from January to April after the harvests, searching for casual labour, during what they call the Exode. Niger is also fast becoming a migration hub towards North Africa and Europe.

While 8 out of ten Nigeriens depend on farming in this country, widespread soil degradation and climate variability make it difficult to sustain a family all year long. Niger experiences drought at least once every two years. Only one percent of the country’s land receives more than 600 mm of rain each year, and just 12 percent of land can sustain agriculture. There is an ongoing food and nutrition crisis across the Sahel and Nigeriens, especially women and their children, suffer as they have less access to productive land to produce food.

For this year’s World Food Day, the FAO calls to change the future of migration by investing in agriculture and food security, especially in the drylands, so that rural families can make a decent living from their farm for them and the next generation.

In 2013, the government of Niger launched the ambitious 3N initiative (Nigeriens Nourishing Nigeriens) to tackle this food security through “agricultural and political transformation”. More inclusive land access, as requested by the upcoming Conference on Land Policy in Africa next November, would be a good step forward. This is an urgent need for Nigerien women who have much limited access to agricultural land and farm assets, despite their central role for family nutrition.

Integrated and natural ways to restore land’s food potential by the women and for the women

More than half of Sahel lands are degraded. Nigeriens are among the poorest, but also the fastest growing population with 4% annual growth rate. Pressure on agricultural lands means farmers cultivate fragile and marginal lands. Unsustainable grazing and farming practices like the clearing of tree cover to plant staple food crops of millet and sorghum, and removal of crop residues to feed animals without alternatives to renew soil fertility have accelerated this land degradation.

A hard red watertight lateritic layer prevents water seeping into the soil and plants to grow. Rural communities have abandoned these degraded common lands to free-range grazing animals and firewood harvesting, as not much grain can be produced there. However, because these soils are rich in clay, they can retain water much better than the sandy soils. And could be a precious food resource during the rainy season if the compacted layer is broken. This is the rationale of the Bio-reclamation of Degraded Lands (BDL) system. BDL combines indigenous water-harvesting techniques, application of organic matter and plantation of high-value trees and vegetables.
The idea is to restore productivity of the barren lateritic soils by using traditional water-harvesting planting techniques, like half-moons or zai pits, for the cultivation of high value vegetables and trees, instead of millets or sorghum as farmers used to do. The impact on incomes and family nutrition makes the intensive labor investment worthwhile.

Agroforestry: Roots to rights, resilience and returns

Over 10,770 women have been trained in BDL, planting nutritious vegetables like okras, sorrel or protein-rich leafy vegetable *Senna obtusifolia*, together with drought tolerant trees like vitamin C rich Pomme de Sahel (*Ziziphus mauritiana*), moringa, sweet tamarind, marula or Australian acacia depending on the families’ needs. In addition to supplementary food, trees can also provide firewood or fodder, shade and live fencing to protect the farming plots against errant livestock.

The other BDL innovation is to negotiate with land owners and the local authorities (village institutions and municipalities) to guarantee land use rights of degraded commons to a women’s group over a long period (fifteen years).

Previous ICRISAT research has shown that a 200 m² BDL plot could yield an annual income of FCFA 50,000 (approximately 100 US dollars), which is equivalent to what men traditionally earn from millet production per hectare. A mid-term evaluation has estimated that women engaged in BDL groups have doubled their incomes compared to other non BDL families. Impact on family nutrition is also undeniable. Vegetable and trees improve diet diversity and bring essential nutrients that the staple foods like millets and sorghum do not have. For instance, the leaves of moringa, a tree originated from Ethiopia, are packed with three times more iron than spinach and four times more calcium than milk. Women also dry surplus okras they gain during the production glut in August-September, so that they cook it later, providing nutritious food supplementation for up to 5 months during the dry season.

Challenges to address and critical lessons learned to scale up BDL

Choice of site is important. BDL is like a green oasis in middle of barren lands that attracts goats and other livestock that don’t have much to eat at this time. To avoid conflicts with herders, it is not recommended to use degraded lands near pasture. Because of free grazing roaming pastoralism in Niger, solid tall fencing or thorny hedges are essential to protect the plants from the start.

Clarification of land ownership with the local authorities is also very important as in some cases, potential owners try to claim the land once the plot becomes productive. From the 167 sites planned initially, half are now cultivated by 87 women’s groups, representing 145 hectares of restored land in a recent assessment.

A close source of water is essential for minimum watering of trees until they are well established. The women’s group for each plot has six trees to take care off. But too much water is not good either as trees have to develop their roots deep in the soil. Watering once a week is enough for the first 2-3 years.

PASAM-TAI’s experience also shows the need for appropriate training and discussion with the families so that they understand that the outcomes even from the first year largely outweigh the required labor to prepare the land. CRS country director, Jean-Marie Adrian, recommends that the community contributes up front with labor and tools, to test the genuine interest for BDL. Providing food for work for instance had some drawbacks, as for some participants, food aid was the reason to join the group, rather than wanting to cultivate the land.

Women’s workload is a dimension any rural project should not ignore. Land regeneration requires physical work especially for the first year when digging zai or half-moon pits. Accompanying measures to reduce women’s workload in the community, such as providing a communal grinding mill or piped water system would help.

ICRISAT scientist Fatondji Dougbedji, stresses that though BDL is meant for women, husbands and other men of the community should be encouraged to assist them for the planting work, especially at the beginning. After the first harvests, most families are convinced.

Looking at the impact on incomes and family nutrition, BDL ticks many boxes: gender, food and nutrition security and climate resilience. We need to scale up this inclusive farming practice so more families in rural Niger nurture their roots in a more food secure community.

The 5 year project PASAM-TAI is funded by USAID’s Food for Peace and led by the NGO Catholic Relief Service and the research organization ICRISAT, part of the CGIAR, aims at reversing both the gender and environmental handicaps of poor land rights for women and widespread land desertification through the Bioreclamation of Degraded Lands (BDL).
“I turned the desert green with sorghum” – ICRISAT to help Iranian farmers grow its mandate crops

Extreme water shortages, overuse of groundwater, continued drought, degraded soils, increasing salinity and rising temperatures – Iran’s farmers battle a host of adversities. Rising temperatures and depletion of water resources have the highest levels of government worried.

As Dr Abbas Keshavarz, Deputy Minister for Crop Production, noted, “We have to save water to save our country. We need to do this with crops that can survive with less water. We have passed the point of replenishing what we use and groundwater is in crisis. About 55% of our irrigation water comes from groundwater.”

In dire need to transform Iran’s agricultural systems to cope with these challenges, several Iranian ministries have joined hands to escalate solutions. As part of these efforts, ICRISAT’s expertise in its mandate dryland crops was sought, with sorghum, millets and chickpea being seen as critical savior crops.

At the invitation of the Iranian Agricultural Research, Education and Extension Organization (AREEO), an ICRISAT delegation travelled to Iran during 1-6 October 2017 to assess opportunities for collaboration. Speaking to the team, Dr Eskandar Zand, Deputy Minister–Agriculture, and Head of AREEO, said, “If we are to achieve sustainable agriculture in Iran, these crops you are working on are very important.”

Iran currently produces sugarcane, wheat and maize, but as Dr Babak Nakhoda, Head, Department of Molecular Physiology, Agricultural Biotechnology Research Institute pointed out, these crops require extensive irrigation, as opposed to crops like sorghum and millets that can grow on less water and fewer inputs.

Interacting with ICRISAT scientists, farmer Moobed explained, “We have had eight years of drought; four years ago, this was just desert. When I planted, it was 50°C and the maize did not produce. Now I have moved from maize to sorghum. I have a crop. And I turned the desert green with sorghum.”

However, there is little to no consumer awareness on the nutritional benefits of these crops, and even those with diabetes and gluten allergies continue to import grains like quinoa for their consumption. Even dairy producers, who could benefit from sorghum and millet for fodder are reluctant, since their existing practice of using maize fodder gives good results. Only foxtail millet (commonly known as gavar), an ancient grain of a specific area in southeast Iran, is eaten even today, especially during winter because of its warming effect and by those fasting during Ramadan because of its slow digestibility. However, the grain is restricted to this particular area.

With increasing temperatures and stresses, many farmers have little option but to switch to dryland crops. Farmer Maleki and his son selected millets to cope with environmental degradation and climatic changes. They used to have an orchard 25 years ago but irrigation led to high soil salinity and all their trees died. “We now grow foxtail and proso (common) millet. We really had no choice as nothing else could survive in these soils.”
After extensive interactions, experts noted that a change in Iran’s agriculture towards more sustainable dryland crops would only be successful if the entire value chain was considered. A holistic approach requiring soil and water management, capacity building of scientists and farmers, through to market development is needed. Several priority areas for collaboration were discussed, with particular emphasis on sorghum and millet industry development to target alternatives to maize and alfalfa in marginalized areas.

Collaborations in R&D on crop improvement to modernize breeding programs in the country and to promote the use of genomic tools to accelerate the process were emphasized, in addition to capacity building of scientists and extension staff. Another priority discussed was to make chickpea a part of the government’s program to enhance food security, with a strong crop improvement component. Better farm management practices, demo plots for farmers, and innovation platforms were also discussed as important ways forward, in addition to the development of consumer markets of Smart Food.

It was decided that immediate actions would include sharing of improved germplasm and genetic material from the ICRISAT genebank with AREEO researchers. Further, exchange programs for students and workshops for knowledge sharing between scientists will be facilitated, to monitor progress on the breeding programs.

A survey showed that most information about scientific technologies and practices was not reaching the farmers. A major new extension approach being set up includes mobile apps targeting farmers; focused areas for extension officers; webinars to farmers through video conferencing; creation of educational videos for farmers; and publications made open access and on a database.

Agriculture in Iran – an overview

- 4 million farms with an average size of 0.7 ha
- 16 million people work on the farms
- 47% employment from agriculture
- 10,000 agriculture extension advisors
- 120 million ha are affected by soil erosion
- 40 million ha are affected by wind erosion
- 2 billion tons of soil are lost every year through erosion
- High soil and groundwater salinity due to long-term irrigation schemes.
- Climate change has led to extreme temperatures and reduction in rainfall; more extreme high and minimum temperatures, especially in winter.
- Water runoff is managed through underground dams

Chickpea
- Grown on 600 ha with a target to reach 1000 ha (Abbas)

Sorghum
- 2 varieties are grown (50% is the Pegah variety based on ICRISAT germplasm and developed by AREEO and Speedfeed, a hybrid from Australia)
- No hybrids

Millets
- Grown on 10,000 ha
- Only pearl, foxtail and common (proso) are grown
- No hybrids

Genebank
- Includes 8000 legumes but none have been fully characterized
- Contains approximately 3000 chickpeas accessions, mainly from Iran
- There is only minimal usage of this material

About 95% of farmers have smartphones but agriculture-relevant information is rarely shared through mobile technologies.

Agriculture in Iran – an overview

Farmer Maleki and his son now grow foxtail and proso millet on their fields.

About 95% of farmers have smartphones but agriculture-relevant information is rarely shared through mobile technologies.

This work contributes to UN Sustainable Development Goals

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ICRISAT in Global News

Pearl millet genes hold key to climate-proof cereals

A team of scientists from ICRISAT, India; Institut de Recherche pour le Développement (IRD), France; and BGI, Shenzhen, China; have discovered that pearl millet’s ability to thrive in high temperatures (up to 42˚C) is owing to certain genes in its DNA. This breakthrough research finding bodes well for the cereal as it can be used to fight malnutrition amidst severe climate change.

Pearl millet genes hold key to climate-proof cereals

The groundnut crop around the world, especially in the dryland regions, is beset by a toxic fungus Aspergillus that produces deadly aflatoxin, which can lead to illness, malnutrition and even death. Scientists at ICRISAT have finally found a way to impart immunity to groundnut plants, using biotechnology tools.

Le mil, le sorgho et les légumineuses à grains sont des smartfood! – ICRISAT

Though millets and sorghum have been around since ancient times, they have been grossly underutilized in most parts of the world. Now, with awareness about their nutritive properties, more and more people are attempting to include them in their diets. More importantly, they constitute a solution to the major problems of poverty, malnutrition, climate change and environmental degradation.
Meetings and Workshops

Phytosanitary week

International Phytosanitary Awareness Week: 23–27 October

Preserving the genetic diversity of dryland crops for posterity: The role of phytosanitation

The ICRISAT genebank in India chronicles over 10,000 years of cultivated dryland crops history. It conserves over 120,494 seeds and accessions of dryland cereals and legumes from 137 countries. This genetic diversity has also been saved for posterity in the Svalbard Global Seed Vault also known as the ‘doomsday vault’, in Norway. Safeguarding, maintaining and expanding valuable collections in genebanks is a humongous task.

The aim of phytosanitation is to ensure that seed and plant materials are pest and disease free. At ICRISAT, this task is under the responsibility of the Plant Quarantine (PQ) and Germplasm Health Unit. This unit is also responsible for the international exchange of germplasm and for ensuring that the plant material periodically regenerated by the genebank is clean. It services the genebank, the breeding units of the mandate crops and also other CGIAR centers housed at ICRISAT.

As the Germplasm Health Units (GHU) of CGIAR Research Centers observe International Phytosanitary Awareness Week, exceptional achievements in this domain deserve mention. From 1973 to 2016, ICRISAT, in collaboration with the Indian authorities, facilitated export of 1.32 million seed samples of ICRISAT’s six mandate crops and small millets to 173 countries, and imported 180,000 seed samples from 96 countries, without introduction of any exotic pests into the importing country and in India.

International exchange of germplasm is critical to genetic improvement of crop cultivars to meet the ever-increasing demand of food, feed and fodder and also to create backups in other locations in case of a manmade or natural disaster (the recent case of the seed bank in war-torn Syria was an eye-opener for international genebanks for creating emergency backups).

International movement of seed material increases phytosanitary risks such as introduction of exotic insect pests and pathogens. In India, ICRISAT’s Plant Quarantine Laboratory (PQL), in collaboration with the National Bureau of Plant Genetic Resources (NBPGR) of the Indian Council of Agricultural Research (ICAR) and the Directorate of Plant Protection Quarantine Storage (DPPQS), plays an important role in minimizing such risks.

Elaborating the significance of phytosanitation.

Photo: S Punna, ICRISAT
“The role of PQL is crucial to prevent the entry of exotic pests which have the capacity to blow up into large-scale epidemics that can wipe out entire crops,” says Dr Rajan Sharma, Head, Plant Quarantine Unit, ICRISAT. A recent article in the *The Guardian* on the fall armyworm destroying cereals in Africa clearly illustrates this. “Originally from the Americas, caterpillars eat maize, a staple in many African countries. So far, they have been found in 28 African nations – 16 more than they were detected in five months ago. If nothing is done, they could eat between 20% and 50% of the maize produced in 12 of Africa’s maize-producing countries...” says the article.

Referring to the many stringent measures that are taken at ICRISAT with regard to phytosanitation, Dr Sharma cites the example of how a possible epidemic of downy mildew in hybrid pearl millet was contained.

### Major diseases detected

Till date, 69 insect pests and pathogens of quarantine importance have been detected in imported seed materials and 53 in the seed samples processed for exports. The major diseases detected at the post-entry quarantine isolation area (PEQIA) at ICRISAT are:

#### Fungal diseases
- Wilt (*Fusarium udum*) in pigeonpea from Indonesia (1999)

#### Bacterial diseases
- Bacterial leaf streak (*Xanthomonas vasicola pv. holcicola*) and Bacterial leaf stripe (*Pseudomonas andropogonis*) in sorghum from the Yemen Arab Republic (2003)

#### Viral disease

Some of these infected consignments could be partly salvaged, while some had to be incinerated.

### Phytosanitary Awareness Week: For seed and plant health biosecurity

As part of the International Phytosanitary Awareness Week program, national and regional station heads of ICAR-NBPGR were invited to address ICRISAT scientists on 26 October.

Dr SC Dubey, Principal Scientist and Head, Division of Plant Quarantine, spoke on *Importance of ‘germplasm health’ in preventing transboundary spread of pests and pathogens*. He cautioned that seed-borne pests and pathogens can survive in genebanks for decades and care needs to be taken to ensure seed health. He said that in India there was a need to improve screening procedures as there have been recent instances where new pests, pathogens and weeds have been introduced through imports. He commended ICRISAT and other CGIAR centers for maintaining a good track record over the last 50 years.

Dr Sarath Babu, Principal Scientist and Officer-in-charge, Regional Station, Hyderabad, spoke on *Emerging challenges to international distribution of germplasm*. He dwelt on the recent stringent export regulations introduced in India to safeguard the nation’s biodiversity. In fact, a recent article that appeared in the *Financial Express* tells how Indian officials were able to contain damage on discovering the entry of wheat blast disease from Bangladesh.

In the question-answer session that followed, ICRISAT scientists talked about the difficulty they were facing in exporting material of ‘unknown’ origin or those that had even one line of Indian origin (not FAO designated) in their pedigree. The officials said that a permission from the National Biodiversity Authority was needed and that with the introduction of online filing, the process is taking much lesser time than before.

Dr Suhas Wani, Research Program Director-Asia, presided over the seminar and urged the scientists to share their learnings from the seminar with colleagues. Dr Rajan Sharma, who organized the seminar, highlighted the role of ICRISAT PQU/GHU in international distribution of pest-free germplasm.
Screening processes

The ICRISAT Plant Quarantine Laboratory uses state-of-the-art screening tools and techniques for pest and disease detection that include tests like ELISA, agar and radiography depending on the crop. Suitable seed dressing chemicals are used to eliminate seed-borne organisms during export/import.

The various legal requirements for the issuance of a phytosanitary certificate and import permit are meticulously followed. India is a signatory to the World Trade Organization’s Sanitary and Phytosanitary Agreement and since 1986, NBPGR is the regulating agency for exports and imports. All imported crop germplasm are grown in isolated plots (PEQIA) or the PQ greenhouse for pest and pathogen inspection and release by NBPGR.

Currently, ICRISAT’s PQL is working towards using more sensitive diagnostic tools that facilitate molecular detection of pests and pathogens.

Emerging challenges to international distribution of germplasm

Importance of ‘Germplasm Health’ in preventing transboundary spread of pests and pathogens
Scientists from UK and India collaborate for crops with higher nitrogen-utilization efficiency

Agricultural scientists from the United Kingdom and India discussed ways of developing crop varieties with better nitrogen absorption and utilization at the annual meeting of the Cambridge-India Network for Translational Research in Nitrogen (CINTRIN).

The global demand for nitrogen (N) fertilizer for agriculture is projected to reach ~250 million tons per year by the year 2050 (from the current ~110 million tons per year). A substantial amount (>50% in some cases) of N applied to the soil is lost by leaching, runoff and denitrification. In addition to adding to the crop production costs, these processes pollute the groundwater, adversely affect soil structure, and damage the environment through increase in levels of nitric oxide, ozone etc.

CINTRIN aims not only to improve the income and livelihood of farmers by reducing inputs cost, but also to save the environment by minimizing the negative impacts of excessive use of fertilizers.

- CINTRIN scientists are studying the natural variation for nitrogen use efficiency (NUE) in diverse crops such as wheat, sorghum, pearl millet and foxtail millet. The findings will be applied to develop new breeding lines with enhanced NUE.
- CINTRIN also uses model plants such as Arabidopsis and Brachypodium for basic research which will be translated into crops in future.
- In addition, it will deliver a translational pipeline to produce new cereal varieties for optimized nitrogen use in agriculture.

During the three-day meeting, the teams led by Principal Investigators Dr Rajeev Gupta (Principal Scientist & Theme Leader-Genomics and Trait Discovery, ICRISAT), and Dr Tina Barsby (CEO, NIAB), discussed the progress made in each of the six ‘Work Packages’ (goals) in the four target crops and shared lessons learnt which could be used to drive future plans.

CINTRIN is led by ICRISAT, India, and the National Institute of Agricultural Botany (NIAB), UK. It is one of four Virtual Joint Centres in Agricultural Nitrogen, delivered in partnership by the Biotechnology and Biological Sciences Research Council (BBSRC), Newton Fund, and the Department of Biotechnology India (DBT). CINTRIN held its annual review meeting at ICRISAT HQ from 5-7 October 2017.

Partners: Punjab Agricultural University, Ludhiana, India; National Institute of Plant Genome Research, New Delhi, India; Biotechnology and Biological Sciences Research Council (BBSRC); the Newton-Bhabha Fund; Department of Plant Sciences and The Sainsbury Laboratory, Cambridge University; ADAS Ltd, UK; KisanHub, UK

This work contributes to UN Sustainable Development Goals

Photo: PS Rao, ICRISAT

The CINTRIN team at ICRISAT.
Raising smallholder legume farmers’ productivity in Myanmar through MyPulses

Smallholder farmers in Myanmar engaged in legume farming have benefited from the strong partnership between Myanmar and ICRISAT, India, in grain legumes improvement research over the last 30 years.

A recent review meeting of the MyPulses (Increasing productivity of legume-based farming systems in the Central Dry Zone (CDZ) of Myanmar) project (2014–2017) highlighted its contributions towards improving the livelihoods of Myanmar’s legume farmers through research and extension. The CDZ spans 80,000 sq km in central Myanmar, where annual rainfall ranges from 500 to 1000 mm. Legume crops, grown on about 2.5 million ha, are important in this region.

- ICRISAT has supplied about 500 improved breeding lines of chickpea, pigeonpea and groundnut to the Department of Agricultural Research (DAR) in Myanmar.
- Nine out of ten varieties of chickpea, six out of nine varieties of pigeonpea and five out of ten varieties of groundnut released in Myanmar are from ICRISAT-supplied germplasm and breeding lines.
- Chickpea production has seen a 728% increase (from 67,900 tons to 562,000 tons).
- Pigeonpea production has achieved a 266% increase (from 157,000 tons to 575,100 tons).
- Groundnut production has jumped 54% (from 561,700 tons to 865,900 tons) in 15 years (1999–2014).
- The compound annual growth rate in yield during this period was 4.7% for chickpea and 2.6% for pigeonpea and groundnut.

During 2014, the average yields of chickpea, pigeonpea and groundnut in Myanmar were 1460, 940 and 1790 kg/ha, respectively, which are 48.7%, 35.3%, and 8.2% higher than the global average yields.

Over 600 on-station mother trials and on-farm baby trials were conducted on improved varieties/candidate varieties of chickpea, pigeonpea and groundnut using farmer participatory varietal selection (FPVS) approach.

Quality seed of high-yielding varieties are produced and distributed using the Village Seed Bank model. Across the CDZ, there are about 430 seed banks producing and selling seed (as of 2016–17).

ICRISAT has also provided training to scientists and extension personnel from DAR and the Department of Agriculture (DoA), Myanmar, on breeding, crop and seed production of grain legumes, and integrated pest management, through field days and in-country training sessions.

The project’s annual review meeting was held on 10-11 October 2017 at DAR, Yezin, Myanmar. ICRISAT participants included Drs Pooran Gaur (Project Coordinator from ICRISAT), P Janila, Anupama Hingane and D Kumaracharyulu.
Empowering women to bridge gender productivity gap

In early 2017, a gender study was conducted among 200 smallholder farmers from 20 communities in Ghana. It revealed that male groundnut farmers achieved 2.74% higher productivity compared to their female counterparts in the Northern Region of Ghana; in the Upper East and West Regions, the corresponding figures were 3.24% and 6.60% respectively. Among the prime factors determining productivity were membership of social groupings; use of improved seeds; participation in field trials; area under crop cultivation; years of experience in groundnut production; soil fertility status of fields and labor cost. The study showed that women farmers were probably unable to access and fully utilize these to achieve full production potential of their farms.

Based on the results of this study, scientists, farmer groups and other stakeholders brainstormed ideas to reduce the significant productivity gap between male and female groundnut farmers in Ghana. The workshop was organized by the CSIR-Savanna Agricultural Research Institute (SARI) with support from the Tropical Legumes III (TL III) project.

Stakeholder recommendations

- Encourage women to grow ‘Gender-sensitive’ crops, which are less labor- and machinery-intensive, so that they can be grown with minimal assistance.
- Form gender-based groups geared towards agricultural production should be encouraged as they acted as conduits for accessing credit and other financial assistance to enhance production.
- Form community-based seed production groups to produce quality seeds at reduced prices to help more farmers gain access to improved seeds.
- Motivate women farmers to participate in field trials or demonstrations, which serve as sites for technology transfer.
- The government should draft financial policies that enabled farmers to take loans to expand production.
- Encourage greater participation of women in groundnut innovation/multi-stakeholder platforms.
- Set up schools close to farming communities and imparting training in local dialects.
- Introduce more Village Loans and Savings Associations (VLSA) to provide credit to female farmers.
- The Ministry of Gender, Children and Social Protection must empower vulnerable women in the communities, by way of policy and aid, to take up crop production.

Dr Jummai Yila, Gender Specialist –TL III, West and Central Africa, said, “It is important to relay the findings of this survey back to the communities to create awareness on basic issues, so that they can be handled by them.”

Yield levels, rates of input use, rates of adoption of modern technologies, and access to credit and insurance markets have been identified over the years as the fundamental factors that control agricultural productivity. By empowering women farmers with these tools, scientists hope to see an overall increase in groundnut productivity, which would be instrumental in reducing food insecurity and poverty rates in Ghana, particularly in rural areas.

Project: Tropical Legumes III

Partners: International Center for Tropical Agriculture (CIAT); International Institute for Tropical Agriculture (IITA); Council for Scientific and Industrial Research - Savanna Agricultural Research Institute (CSIR-SARI), NARS from selected countries, and ICRISAT

Funder: Bill & Melinda Gates Foundation

This work contributes to UN Sustainable Development Goals

Dr Jummai Yila, Gender Specialist –TL III, West and Central Africa talks to farmers in the Upper East Region of Ghana.

Photo: R Oteng-Frimpong, Ghana
I’ve been associated with ICRISAT since 2015, when ICRISAT came to Siaya county in Nyanza province. These regions are rainfed, with just 500-600 mm of rainfall a year. Since ICRISAT first brought seeds of sorghum, finger millet and green gram, there’s food and peace in the region. However, due to lack of information, farmers are not adopting these crops. During the workshop, I learnt more about how these crops can be used to make tasty and nutritious recipes and processed for markets using small machines. I want to take this knowledge to farmers in my region to create employment opportunities for their children and protect them from companies that exploit them by underpaying for their produce,” said Ms Priscilla Roberts, an extension worker from Kenya who took part in a training program conducted to enhance capabilities of African NARS partners of ICRISAT in food processing (including technologies and business opportunities).

The capacity building and training program was held at ICRISAT, through its Agribusiness and Innovation Platform (AIP) under the India-Africa Forum Summit III (IAFS-III). The 15-day training program ‘Technologies and Business Opportunities in Food Processing for SMEs’ was conducted during 9–20 October 2017, to boost the nations’ economies by promoting food-based entrepreneurship.

This training program focused on several aspects of food processing, with key areas being the Identification and mapping of opportunities, value chain analysis and development, food safety and compliances, business plan development and raising capital for SMEs, intellectual property rights and technology rights, leveraging ICTs for digital agriculture and food supply chains, advances in food processing technologies, and the setting up of incubators for promoting entrepreneurship.

Participants obtained hands-on training on several technologies and learnt how to set up processing units based on these technologies. The training program included lectures by industry experts and talks based on personal entrepreneurial journeys by successful entrepreneurs. This gave the participants inspiration and ideas about starting small- and medium-sized enterprises (SMEs) and managing them profitably. The trainees also visited the pilot facility at NutriPlus Knowledge Centre, Indian Institute of Millet Research, Centre for Entrepreneurship Development, Grameen Mall at Hyderabad and SV Agri and National Institute of Post Harvest Technology (NIPHT) at Pune.

“We have been exposed to a number of value-added products, like millets, sorghum and Irish potatoes in this training program. After this, I want to help farmers grow these crops. In collaboration with partners like ICRISAT, I want to revive interest in these crops and in consuming and processing them using appropriate machinery. Because of the workshop, I realized that in addition to banana processing, there is a lot of potential in sorghum and millets. I am now looking to diversifying into those value chains so I can get products of a higher value,” said Mr Adams Nkwatsibwe, Director, Noble Agro Innovations Ltd, Uganda.

The training program was organized with support from the Ministry of External Affairs, Government of India. Participants consisted of 35 delegates (including 16 women) from 12 African nations: Kenya, Ghana, Nigeria, Tanzania, Zambia, Uganda, Niger, Mali, Mauritius, Namibia, Sudan and South Sudan.

Under the IAFS-III, AIP has been entrusted by the Indian Ministry of External Affairs to organize three training programs of which this was the first. The second training session on ‘Entrepreneurship and Marketing Skills Development’ will be held during 12-25 November 2017 at ICRISAT.

Participants express their views on the food processing workshop
The Food and Agriculture Organization (FAO) selected several locations of the Tropical Legumes III (TL III) project to illustrate the learning of good practices in crop breeding and seed delivery. It facilitated a three-day program in Addis Ababa, Ethiopia, focused on the ‘Use of quality seed and adoption of improved crop varieties’, for agricultural experts from eight African countries: Cameroon, Chad, Cote d’Ivoire, Democratic Republic of Congo, Mali, Mozambique, Rwanda and Zambia.

The organizations identified for this visit were three government institutions: Ethiopian Institute of Agricultural Research (EIAR), Ethiopian Agricultural Transformation agency (ATA), Ethiopian Agricultural Business Corporation (EABC); and three CGIAR centers: International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), International Center for Agricultural Research in the Dry Areas (ICARDA) and International Maize and Wheat Improvement Center (CIMMYT).

As a result of the field tours to seed production areas and presentations on work done on the seed systems in Ethiopia, the representatives took away the following lessons:

- Community-based clustered seed production can effectively complement the formal seed sector.
- It is a viable option to promote often-neglected ‘orphan’ legume crops such as chickpea.
- Intervention by organizations such as ICARDA and ICRISAT, working with EIAR, has strengthened farmer organizations’ capacity to produce quality seed (at least QDS).
- A few farmer organizations have grown to PLC (company) levels.

The key message that emerged was that by increasing availability and adoption of improved varieties, seeds and associated production packages, productivity of legumes in the drought-prone areas of sub-Saharan Africa was being boosted.

During the tours, held on 12, 13 and 16 October 2017, the visitors were accompanied by two senior experts from FAO. Dr Asnake Fikre coordinated this visit on behalf of TL III, ICRISAT.

### Project: Tropical Legumes III
**Partners:** International Center for Agricultural Research in the Dry Areas (ICARDA), International Institute for Tropical Agriculture (IITA), Ethiopian Institute for Agricultural Research (EIAR), NARS from the selected eight countries and ICRISAT

**Funder:** Bill & Melinda Gates Foundation

This work contributes to UN Sustainable Development Goals
Farmers in Dawakin, Nigeria, celebrate introduction of improved cowpea varieties

Farmers in the rural community of Dawakin Tofa Local Government Area of Kano State, northwestern Nigeria, were mainly subsistence farmers trying to earn a living from the harsh environmental conditions prevalent in the area noted for poor rainfall and nutrient-deficient soils causing repeated crop failures.

Two years ago, extension agents of the International Institute of Tropical Agriculture, working with the Kano State Agricultural and Rural Development Authority (KNARDA) implemented a Tropical Legumes III (TL III)-funded project, under which:

▪ They introduced improved cowpea varieties to the villagers. These new varieties were resistant to the parasitic weed, *Striga gesnerioides*, which had been a menace to farmers in the area.

▪ The extension agents experimented in several small plots in farmers’ fields in the village to demonstrate the potential of cowpea-based farming systems and the use of improved cowpeas for quality seed production.

▪ Farmers were mobilized and organized into viable community-based organizations (CBOs).

▪ Innovations in crop production systems were applied.

▪ Farmers were linked with input dealers and large-scale seed buyers to guarantee post-production markets.

As a result:

▪ The farmers produced more than their consumption needs.

▪ They sold the surplus for better incomes.

▪ This year, they expect even better yields and higher income from their cowpea seed farms.

In order to celebrate these successes, and to highlight the potential of a new cowpea variety, a farmer’s field day was organized on 29 September 2017, in Dawakin. Representing the district head, Alhaji Mahammud Ubale appealed to KNARDA to “bring more of this seed for dry season farming in the community and also sell the seed to members of the community for next year’s planting”.

A total of 170 farmers (135 men and 35 women), traditional rulers, government and TL III project representatives and other stakeholders, including Dr Chris Ojiewo, TL III project manager, attended the field day.

**Project:** Tropical Legumes III  
**Donor:** Bill & Melinda Gates Foundation  
**Partners:** International Center for Tropical Agriculture (CIAT); International Institute for Tropical Agriculture (IITA); NARS from selected eight countries; University of Agriculture, Makurdi; Kano State Agricultural and Rural Development Authority (KNARDA) and ICRISAT

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Farmers gather for a field day at Dawakin.

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This work contributes to UN Sustainable Development Goals

2 END HUNGER

8 DECENT WORK AND ECONOMIC GROWTH

17 PARTNERSHIPS FOR THE GOALS
Announcement

Dr Anthony Whitbread, Research Program Director - Innovation Systems for the Drylands, has been selected as a member of the new Executive Committee of the Agricultural Model Intercomparison and Improvement Program (AgMIP).

This nomination to the Executive Committee reflects the growing interest in, and impact of, scientific contributions of the AgMIP community through its global network of researchers. Members of the Executive Committee are internationally recognized leaders for their sustained scientific and technical contributions to agricultural sciences, and they will play a major role in developing the AgMIP scientific pillars, partnerships, protocols, and projects, with active participation of AgMIP researchers and sponsors.

Newsfeed

Malnutrition: It’s about more than hunger

Not True that Hunger Doesn’t Discriminate — It Does

Food Insecurity and Forced Displacement of People: Where do we Draw the Line?

Cities and local policies key to overcome hunger, stresses head of UN agency

Kenya’s vegetable evangelist claims a prize – and takes on climate change

AfDB’s agricultural transformation strategy to guarantee 513 million tons of additional food production

The Road Out of Poverty Depends on Feeding Our Children Nutritious Food First

Driven to Extremes—How Poverty Fuels Extremism, and How to Help Africa’s Youth

FAO, WFP reaffirm their commitment to working for Zero Hunger in the Middle East

Malnutrition kills more Indians than any specific disease, yet successive governments pay scant attention

One-third of those involved in agriculture in India are women: Centre

Can India meet sustainable development goals on poverty, hunger despite sluggish economy?

Women are Pivotal to Addressing Hunger, Malnutrition and Poverty

The viability crisis in Indian agriculture

Karnataka takes the lead in lobbying with FAO for an ‘international year of millets’

Harappans changed crops to suit climate change: Study

Sad News

We regret to announce the passing away of Mr Emmanuel Mkuwamba, scientific support staff based at Chitedze, Malawi on 24 October 2017, due to complications arising from high blood pressure and diabetes. Emmanuel was instrumental in keeping alive the breeding pipeline for ESA’s groundnut breeding program and, along with Dr E Monyo, in rebuilding the program to provide germplasm to the whole region. In recent years, he also handled on-station and on-farm research activities because of his excellent skills in data collection and analysis. He will be deeply missed. Our condolences to Emmanuel's family and colleagues for their loss.
New publications

The genotypic and phenotypic basis of chickpea (*Cicer arietinum* L.) cultivars for irrigation-based production in Ethiopia

Authors: Girma N, Fikre A and Ojiewo CO
Published: 2017, Journal of Agricultural Science, 9 (8). pp. 229-236. ISSN 1916-9760

Abstract: Development of irrigation-based chickpea production is considered the most important alternative approach in combating climate change and maximizing productivity, especially in moisture-stress areas and in areas where water and land for irrigation is available. In central Ethiopia, where production of chickpea (especially Kabuli type) is becoming an important part of agriculture, although many superior varieties (both desi and Kabuli types) are available, they have been evaluated and released based on rainfed production. Hence, there is an urgent need for evaluation of varieties suited for irrigation-based production. Towards this goal, during the 2012/13 growing season, 14 Kabuli genotypes (previously introduced) and 24 desi genotypes (nurseries obtained from ICRISAT) were evaluated independently at three and one locations respectively (Kabuli at Debre Zeit, Ambo and Werer; desi at Debre Zeit) for production adaptation under irrigation. The result of combined analysis indicated five promising genotypes showing more than 20 kg/ha yield on average. All desi varieties showed maturity dates of under four months; six genotypes showed higher 100-seed weight and eight genotypes showed promising yield responses (> 2000 kg/ha). From these preliminary results, it can be deduced that irrigation can play a significantly complementary role to the rainfed system, provided the genetics by management is optimized through research and innovation.

http://oar.icrisat.org/10103/

Understanding growth and development of three short-season grain legumes for improved adaptation in semi-arid Eastern Kenya

Authors: Sennhenn A, Njarui DMG, Maass BL and Whitbread AM
Published: 2017, Crop and Pasture Science, 68 (5). pp. 442-456. ISSN 1836-0947

Abstract: Short-season grain legumes play an important role in smallholder farming systems as source of food and to improve soil fertility through nitrogen fixation. However, it is not clearly understood how these diverse legumes contribute to the resilience of such systems in semi-arid environments. We describe the growth, development and resource-use efficiency (focusing on radiation, RUE) of three promising short-season grain legumes: common bean (*Phaseolus vulgaris* L.), cowpea (*Vigna unguiculata* (L.) Walp.) and lablab (*Lablab purpureus* (L.) Sweet). Planting density strongly influenced the production success of cowpea and lablab, with high plant densities leading to vigorous growth habit with low podset establishment. Such information on temporal and spatial differences in growth, development and resource-use efficiency is highly valuable for crop-modelling applications and for designing more resilient farming systems with short-season grain legumes.

http://oar.icrisat.org/10104/

Marker-assisted introgression of resistance to Fusarium wilt race 2 in Pusa 256, an elite cultivar of desi chickpea

Authors: Pratap A, Chaturvedi SK, Tomar R, Rajan N, Malviya N, Thudi M, Saabale PR, Prajapati U, Varshney RK and Singh NP
Published: 2017, Molecular Genetics and Genomics. pp. 1-9. ISSN 1617-4615

Abstract: Fusarium wilt caused by *F. oxysporum* f. *sp. ciceris* causes extensive damage to chickpea (*Cicer arietinum* L.) in many parts of the world. In the central part of India, pathogen race 2 (Foc 2) causes severe yield losses. We initiated molecular marker-assisted backcrossing (MABC) using desi cultivar, Vijay, as a donor to introgress resistance to this race (Foc2) in Pusa 256, another elite desi cultivar of chickpea. To confirm introgression of resistance for this race, foreground selection was undertaken using two SSR markers (TA 37 and TA110), with background selection to observe the recovery of recurrent parent genome using 45 SSRs accommodated in 8 multiplexes. F1 plants were confirmed with molecular markers and backcrossed with Pusa 256, followed by cycles of foreground and background selection at each stage to generate 161 plants in BC3F2 during the period 2009–2013. Finally, 17 BC3F4 and 11 BC3F3 lines were obtained which led to identification of 5 highly resistant lines of Pusa 256 with Foc 2 gene introgressed in them. Development of these lines will help in horizontal as well as vertical expansion of chickpea in central part of India.

http://oar.icrisat.org/10107/

Possible effect of threshing method on grain iron and zinc density estimation in pearl millet: a contribution to biofortification breeding

Authors: Govindaraj M
Published: 2017, Electronic Journal of Plant Breeding, 8 (2). pp. 668-673. ISSN 0975-928X

Abstract: In crop biofortification research, threshing part is the primary place of contamination while dealing with grain mineral traits such as iron (Fe) and zinc (Zn) density. Thus, the type of threshing operation is one of the important and effective factors for efficient grain mineral traits determination. This study is aimed at the effects of threshing methods, namely power-operated single-head thrasher and manual-hand threshing on Fe and Zn density estimation. This study indicated that high levels of consistency on ranking of test entries and threshing method has no effect on grain Fe and Zn estimation. Therefore, single-head thrasher will be a reliable and faster method for large-number of breeding materials threshing and its grain micronutrient determination in pearl millet biofortification.

http://oar.icrisat.org/10110/
Characterization of post-rainy season grown indigenous and exotic germplasm lines of sorghum for morphological and yield traits

Authors: Badigannavar A, Ashok Kumar A, Girish G and Ganapathi TR

Published: 2017, Plant Breeding and Biotechnology, 5 (2). pp. 106-114. ISSN 22879358

Abstract: Sorghum is a major staple crop and vital for the marginal farmers in Asian and African countries. Landraces or germplasm lines adapted to biotic and abiotic stresses are the prime source of adaptive traits in the crop breeding programs. In order to assess the genetic variability, 141 exotic germplasm lines and 36 popular varieties were evaluated for eight agro-morphological traits. Cluster analysis resolved all the genotypes into four major clusters. Among germplasm lines, TSG-313 had high seed weight of 7.05 g/100 seeds, while TSG-325 had highest grain yield of 124.4 g/plant as against control variety. Germplasm lines with high heritability scores would help us to utilize them in recombination breeding.

http://oar.icrisat.org/10111/

Trade-offs between non-farm income and on-farm soil and water conservation investments of smallholder farmers in the semi-arid tropics of India

Authors: Nedumaran S and Singh NP

Published: 2017, Agricultural Economics Research Review, 30 (1). pp. 47-56. ISSN 0971-3441

Abstract: This paper has examined the trade-off between non-farm income and on-farm soil and water conservation (SWC) investment by smallholder farmers in the semi-arid tropics (SAT) of India. A dynamic bio-economic simulation model has been used to assess the impact of improved off-farm employment opportunities on household welfare, labor allocation for SWC activities. The simulation results have revealed that improved non-farm employment opportunities increase household welfare but reduce the households’ incentives to deploy labor for SWC measures, leading to higher levels of soil erosion and rapid land degradation. The study has suggested that there is the need of other complementary policy interventions to protect the natural resource base because improvement in non-farm income opportunities does not produce a win-win solution in watersheds in the SAT region.

http://oar.icrisat.org/10112/

Assessing the adoption of NERICA varieties in Western Burkina Faso

Authors: Ouédraogo M and Dakouo D


Abstract: This paper aims to assess the actual and potential adoption rate of NERICA (New Rice for Africa) rice varieties and identify the determinants of their diffusion and adoption in Burkina Faso. The surveys were conducted in 2009 among 300 rice farmers in 10 villages participating in the rice varietal selection tests. The average treatment effect (ATE) method made it possible to determine a common rate of exposure to and adoption of NERICA of 17% in 2008, and a potential adoption rate of 37%. This means that there is an adoption gap of 20% due to the incomplete diffusion of NERICA, which must be addressed by carrying out more actions to disseminate these varieties. The contact with agricultural research services is a key factor determining the awareness and adoption of NERICA in Burkina Faso.

http://oar.icrisat.org/10113/

Harnessing finger millet to combat calcium deficiency in humans: Challenges and prospects

Authors: Puranik S, Kam J, Sahu PP, Yadav R, Srivastava RK, Ojulong H and Yadav R

Published: 2017, Frontiers in Plant Science, 8 (1311). pp. 1-16. ISSN 1664-462X

Abstract: Humans require more than 20 mineral elements for healthy body function. Calcium (Ca), one of the essential macrominerals, is required in relatively large quantities in the diet for maintaining sound overall health. Finger millet [Eleusine coracana (L.) Gaertn.], a crop with inherently higher Ca content in its grain, is an excellent candidate for understanding genetic mechanisms associated with Ca accumulation in grain crops. In this review, we assess some recent advancements and challenges for enrichment of its Ca value and present possible inter-disciplinary prospects for advancing the actual impact of Ca-biofortified finger millet.

http://oar.icrisat.org/10115/

Agronomic evaluation of cowpea cultivars developed for the West African Savannas

Authors: Kamara AY, Ewansiha S, Ajeigbe H, Omoigui L, Tofa Al and Karim KY

Published: 2017, Legume Research: An International Journal, 40 (4). pp. 669-676. ISSN 0250-5371

Abstract: The goal of this research was to evaluate diverse cowpea genotypes developed over the past four decades in the Nigerian Sudan Savannas for their agronomic performance and to identify groups of cultivars with similar quantitative characters. Characterization would facilitate the efficient synthesis of breeding populations for further improvement of cowpea. Also superior genotypes with desirable characteristics could be identified and disseminated in the dry savannas of West Africa. Significant variations were observed in the agronomic characteristics of the cultivars in this study. These cultivars could be evaluated on-farm for eventual release to farmers. They could also be used in breeding programs for improvements in grain and fodder yield of cowpea.

http://oar.icrisat.org/10117/
Genome-wide sequencing of longan (Dimocarpus longan Lour.) provides insights into molecular basis of its polyphenol-rich characteristics


Published: 2017, GigaScience, 6 (5). pp. 1-14. ISSN 2047-217X

Abstract: Longan (Dimocarpus longan Lour.), an important subtropical fruit in the family Sapindaceae, is grown in more than 10 countries. It is a source of traditional medicine with polyphenol-rich traits. To gain insights into the genomic basis of longan traits, a draft genome sequence was assembled. The draft genome (about 471.88 Mb) of a Chinese longan cultivar, “Honghezi,” was estimated to contain 31 007 genes and 261.88 Mb of repetitive sequences. No recent whole-genome-wide duplication event was detected in the genome. Whole-genome resequencing and analysis of 13 cultivated D. longan accessions revealed the extent of genetic diversity. These data provide insights into the evolution and diversity of the longan genome. The comparative genomic and transcriptome analyses provided information about longan-specific traits, particularly genes involved in its polyphenol-rich and pathogen resistance characteristics.

http://oar.icrisat.org/10118/