Kirkhouse Times

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Development of new cowpea varieties and their dissemination in Burkina Faso *by Dr Benoit Joseph Batieno*

Highlights

The development of the new varieties is basically assured by the public institutions in Burkina Faso, especially INERA, but the rate of adoption of the new improved cowpea varieties has been low. A participatory rural appraisal conducted in 2007 and 2008 in Burkina Faso by Dr Tignegre and the breeding team showed that the low adoption rate was due to: difficulties accessing improved variety seed, poor commercialization network, damage due to field and post-harvest insects, low soil fertility, Striga attacks, non-availability of large seeded varieties, and low rainfall, lack of seed companies or starting Seed Enterprises supported by AGRA grants like NAFASO, Agro-Production, FAGRI, EPSAB, and farmers organizations.

Dr Batieno

As a response to some of these constraints the cowpea breeding unit has set up a programme that led to the creation of four new cowpea varieties (**Nafi**, **Gourgou**, **Tiligre** and **Komcalle**). This programme was supported by the Kirkhouse Trust Foundation through the use of molecular techniques to speed up the breeding process. The development of these varieties was done using marker assisted backcross and farmer participatory selection methodologies.

Komcalle in the field

Based on the farmers' preferences, the new varieties that are white and rough seed coat got their seed size increase from 25 to 50% as compared to the most cultivated variety which is KVx396-4-5-2D. These varieties are all Striga race 1 resistant. Thanks to KT for the use of markers. These varieties were released in June 2012 and the participatory varietal selection facilitated their adoption. The names of the varieties were given by farmers themselves and expressed their satisfaction. **Tiligre** means 'hope', **Komcalle** means 'end of hunger', and **Nafi** is 'profit'. Impact study was not done but these varieties are replacing significantly the old varieties. **Tiligre** (hope) and **Komcalle** (end of hunger) are taking the lead.

The Seed Sector in Burkina Faso

Despite the recognized importance of high quality seeds, the seed sector in Burkina Faso continues to face difficulties, in spite of a number of interventions made by the government. A major concern is the maintenance of seed quality. The uptake of improved varieties seeds by the resource-poor farmers is inhibited by the cost of seed and by less than perfect channels of communication between the breeders/seed producers and the farmers. The National Seed Development Programme seeks to promote the use of quality seed of improved varieties by making it available at a low price and in sufficient quantity. Apart from short-term subsidy measures, an attempt has been made to improve seed distribution through the formation of the UNPS-BF, which

Acronyms:

AGRA: Alliance for a Green Revolution in Africa
AGRODIA: Association des Grossistes et Détaillants d'Intrants Agricoles
CNRST: Centre National de la Recherche Scientifique et Technologique
CRS: Catholic Relief Services
DGPV: Direction Générale des Productions Végétales
EPSAB: Entreprise de Production de Semences Agricoles du Boulgou
FAGRI: Faso Agriculture et Intrants
INERA: Institut de l'Environnement et de Recherches Agricoles
NAFASO: Neema Agricole du Faso
OCADES: Organisation Catholique pour le Développement et la Solidarité
Six-S: Se Servir de la Saison Sèche en Savane et au Sahel
SNS: Stock National de Securité
UNPS-BF: Union Nationale des Producteurs Semenciers du Burkina Faso

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The four new varieties

numbers about 800 members. Along with various farmer groups and some individual seed producers, the UNPS-BF acts as a producer of certified seed. These seed producers all operate under supervision and are supplied with pre-basic and basic seed by INERA.

Both a formal and an informal system operate in the country to disseminate seed. The public sector partners in the formal sector are CNRST/INERA, which has the responsibility to create new varieties and to manage the production of pre-basic and basic seed, SNS which promotes the seed sector, and DGPV; together with local extension services they act to disseminate improved seed. Non-governmental partners include UNPS-BF, which produces certified seed, the seed trading network AGRODIA, various NGOs (e.g, OCADES, the CRS and the Six S/Naam Group, Africare), which are committed to agricultural development and to assist farmers to produce seed. The goal of the formal sector is to maintain varietal identity and purity, and to produce high quality seed. It is estimated that still around 80% of seed is traded through the informal system, meaning that production is dominated by sub-optimal varieties. Farmer uptake of improved varieties has been disappointing, largely as a result of uneven access to the seed. A major government intervention in operation since 2008 has focused on widening the distribution of improved seed through a substantial subsidy, and this has begun to have a positive impact in terms of uptake of improved varieties.

Kirkhouse Trust Seed Dissemination at a glance *by Dr Becky Lockyer*

The Trust began to take an interest in seed dissemination following the success of many of its marker assisted breeding programmes – what should be done with the new varieties that had been created, and how do they get into the fields of the farmers? We have been fortunate to have our activities in this area guided by the wisdom and experience of our consultant, Dr Eugene Terry. Different programmes have taken different approaches.

Dolichos bean (*Lablab purpureus*), University of Agricultural Science, Bangalore (UAS, B), Karnataka, India
Dr M. Byre Gowda, supported by the Trust, introduced photoperiod insensitivity into HA 4 (Kirkhouse Times No. 4, July 2015), which enables farmers to grow the crop year round. The university itself set up a seed cleaning and production facility. During the year 2015-16 the seed facility produced 400 kg of breeder seed, which was used to produce 5,000 kg of foundation seed and 20,000 kg of certified seed. The seeds produced at University research stations, through farmer participatory approach projects, and through independent growers are then processed, tested for quality treated with insecticides and fungicides, bagged and packed by the University. The farmers pay the full cost of the seed unless it is subsidised by the Government through special programmes such as the Tribal Sun Plan (TSP) or Sub-mission for Seed and Planting Material (SMSP). The value of the seed from 2011 to 2015 is calculated at £5.3m ($6.6m), in excess of £1m per year.

Cowpea (*Vigna unguiculata*), Savanna Agricultural Research Institute (SARI), Tamale, Ghana
The breeder of this project, Dr Francis Kusi, has produced five seed lines which were recommended for approval by the National Variety Release and Registration Committee in June 2016; these five seed lines form the backbone of this project and have been bred for aphid resistance and increased yield.

The dissemination programme is funded by the Trust and it is being implemented in conjunction with the USAID Cowpea Out-Scaling Project (COSP), Tropical Legumes III, and local seed companies, among others. Two approaches are being undertaken. The Public Private Partnership (PPP) project covers three regions of Ghana; in each region three seed

Fig. 1: Inception workshop run by Dr Francis Kusi (SARI, Ghana)

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companies have been selected to be responsible for providing out-grower farmers with all the inputs required (foundation seed, insecticides, fertiliser etc.) in the form of a cashless loan. The CORAF backed Innovation Platform approach has been adopted by this project to train the out-grower farmers as seed producers. The farmers then sell their produce back to their seed company at an agreed time and price, from which the cost of the inputs is deducted. Each seed company works with a group of 30 farmers, and so a total of 270 farmers are coached using this method.

The second approach, the community seed production approach, seeks to target farmers in remote areas who do not usually have access to certified seed. This is being implemented in conjunction with the USAID COSP, Tropical Legumes III, Care International's Pathways program, and the Ministry of Food and Agriculture (MoFA). As part of Farmer Based Organisations (FBOs), farmers will be trained in good agricultural practices and integrated pest management strategies to improve cowpea production.

Some elite farmers will be further trained as seed producers in their respective communities. These individuals will then serve as sources of improved seeds to other farmers in the remote farming communities to ensure access to high quality seed once the project has concluded. The community seed producers will be trained in business management skills in order to sustain their production once the project has ended, and the project will also facilitate the registration of the community seed producers as certified seed producers. The facilitation role of the project will also link them to other market sources to motivate them to increase the scale of production.

Fig. 2: Dr Lucky Omoigui with one of his two released varieties, FUAMPEA 2; UAM, Nigeria

Cowpea (*Vigna unguiculata*), University of Agriculture, Makurdi (UAM), Nigeria

Two of the four Striga resistant lines bred by Dr Lucky Omoigui, under the support of the Trust, were approved for release on 13th October 2016. They will be called FUAMPEA 1 and FUAMPEA 2. Meanwhile, Lucky has taken sabbatical leave to lead the dissemination programme of Tropical Legumes III in Nigeria. This has inevitably delayed the planned dissemination of his cowpea varieties and other lines, and the strategy is currently being adapted through discussions with Lucky and the university. The university has appointed Professor L.L. Bello and Mr Teryima Iorlamen to support the KT programme during Lucky's absence.

Fig. 3: INRAN PI Aichatou Abdoulaye carrying out capacity building training for farmers, extension agents, and technicians

Cowpea (*Vigna unguiculata*), Institut de la Recherche Agronomique du Niger (INRAN), Maradi, Niger

This project is funded solely by the Trust and uses seed varieties produced by the Trust breeding programme, under Dr Lucky Omoigui, at the University of Agriculture, Makurdi, in Nigeria – much of the cowpea bred in Niger is sold in Nigeria, and so the market preferences for farmers are the same.

The PI, Aichatou Abdoulaye, carried out a two day training course for farmers and agricultural extension agents, as well as three technicians from INRAN. At this course they were trained in how to conduct demonstrations on farmer fields, provided the protocol for data collection, and provided with the seed material, fungicide, pesticide, fertiliser and signs to label the plot areas. There are 30 demonstration plots, 10 in each of the states of Maradi, Zinder and Dosso, each managed by a farmer organisation consisting of at least 50 members under the supervision of an extension agent and farmer who attended the training course. The PI and her

Fig. 4: Farmers and the project team on a demonstration plot, Maradi, Niger.

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research team have travelled between plots to ensure the correct execution of the project, provide assistance when needed, and aid in troubleshooting any problems that arose.

Once the demonstration plots have been established and the farming organisations become self-sustaining, new plots can be set up in locations where the farmers have not had access to improved seed varieties. The extension agents will already have experience in management of the demonstration plots which should ideally lead to less "hands-on" work for the PI and researchers in the future.

Fig. 5: Common bean Kablanketi varieties at SUA, Tanzania

Common bean (*Phaseolus vulgaris*), Sokoine University of Agriculture (SUA), Morogoro, Tanzania

Different seed dissemination projects are at different stages in their development. The Trust has a long running common bean programme at SUA which has recently incorporated a PhD student who is looking at farmers attitudes to improved seed. Using the information gained through this project it is intended to construct a seed dissemination strategy that can comprehensively take into consideration the best interests of the nation's farmers, thus ensuring that it is both effective and successful.

What we know

Our experience has taught us that the informal system does lead to dissemination (we have encountered seed produced at IITA in Nigeria being grown in Niger) but it is slow and with few quality controls. Nevertheless, it requires little ongoing investment and is currently the only sustainable method of dissemination.

A formal system is quicker and ensures quality. It needs investment to set up and to continue – it is unlikely to be sustainable at present without continuing subsidy, given the weakness of the commercial sector – although the level of investment is very small relative to the increase in the value of the crop. If we take a look at HA 4, the cost of cultivation at UAS, B is £60 ($75) per acre, and the seed yield is 400 kg per acre. With a selling rate of £0.45 ($0.56) per kg, the net profit amounts to £120 ($150) per acre. For the green pods, the yield is 1,200 kg per acre, with a selling rate of £0.20 ($0.25) per kg, giving a net profit of £180 ($225) per acre.

Further investment in seed multiplication and promotion within smaller areas (i.e. an area which the PI can travel throughout) seems an efficient way to proceed while ensuring that seed being disseminated is of high quality and is marketable, and therefore profitable, for the farmers to whom it is being provided.

Graduations, Promotions & Awards

- Congratulations to **Dr Francis Kusi** who was awarded the Best Researcher Award for the 32nd National Farmer's Day on the 4th November 2016. This is an annual prize awarded by the Ministry of Food and Agriculture to the best agricultural researcher in Ghana. Francis, who is the WACC PI at SARI Ghana, was also promoted to Senior Research Scientist at SARI on 1st July 2016.

- Congratulations to **Professor Percy Chimwamurombe**, University of Namibia, on winning the 2016 Life Scientist of the Year at the National Research, Science, Technology, Engineering and Innovation Awards for Namibia. Percy is a STOL PI and the prize was awarded in-part for his KT supported work developing "marama bean into a climate-smart crop alternative".

- Congratulations to **Dr K.P. Viswanatha**, a former Trust PI working on horsegram at the University of Agricultural Sciences, Bangalore, on becoming the Vice Chancellor of Mahatma Phule Krishi Vidyapeeth (MPKV), Rahuri. MPKV is one of the largest agricultural universities in Maharashtra state. His appointment came into effect on 30th December 2015.

- Congratulations to **Dr C.M. Keerthi**, who was awarded the degree of Doctor of Philosophy for his thesis "Inheritance and Characterization of Candidate Genes controlling Photoperiod-induced Sensitivity to Flowering and Growth Habit in Dolichos Bean (*Lablab purpureus L.*)" by the University of Agricultural Sciences, Bangalore on the 30th October 2015.

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Peristaltic Pump Use *by Tumie Akintewe*

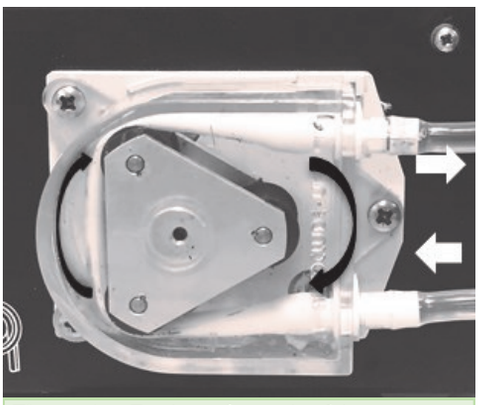

Figure 1a: Design of a peristaltic pump. White arrows indicate the direction of the fluid's point of entry and exit from the pump while black curved arrows indicate the direction of the revolving rollers and fluid flow.

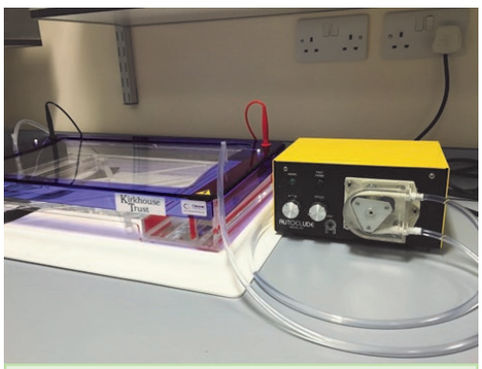

Figure 1b: Peristaltic pump setup ready for extended electrophoresis run.

Gel electrophoresis is one of the most important laboratory techniques used in molecular biology, with Agarose and Polyacrylamide being the widely used gel types. Each type has its own advantage in terms of its resolving power. Polyacrylamide can make gels of high concentration allowing the separation of small DNA fragments which differ by a few base pairs. For this reason, projects supported by the Kirkhouse Trust that explore the use of molecular markers (such as SSRs) which are a few hundreds of base pairs long have chosen polyacrylamide gel electrophoresis as the preferred technique.

Typically to obtain good band resolution particularly between closely migrating DNA fragments, electrophoresis must be performed for an extended period of time. However, the frequent issue encountered during extended runs is the change in buffer composition/pH. Over time, the ions (provided by the buffer) which are responsible for conducting the electric current end up being more concentrated in one part of the electrophoresis compartment than the other. This results in heat generation (known as Joule heating) causing curved or slanted tracks. For this reason, it is important to recirculate the buffer throughout the electrophoresis period with a peristaltic pump.

A peristaltic pump is a positive displacement pump used to transport a variety of fluids. It consists mainly of a tubing which carries the fluid and prevents it from making direct contact with other mechanical parts; a rotor and set of rollers. The tubing is fixed between the rotor and the rigid pump case such that at each point of the roller, the tubing is compressed. In operation, fluid is drawn into the inlet tubing and backward flow is avoided by the compressed region. As the rollers revolve across the tubing, the fluid contained between them is pushed in the direction of the rotor where it moves towards the outlet before it is discharged (**Figure 1a and 1b**).

The gel pictures in **Figure 2a** and **2b** show the effect of using a peristaltic pump for extended electrophoresis runs. Gels were run at 100V for 16hrs, without pumping **(Fig 2a)** or with pumping **(Fig 2b)**.

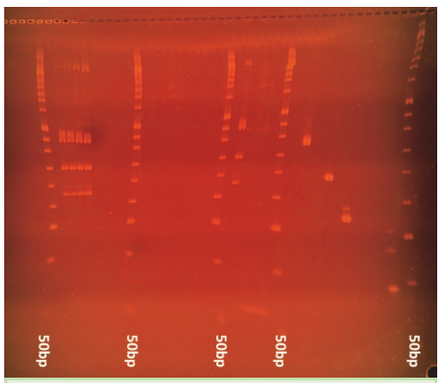

Figure 2a: Gel electrophoresis of samples without using a peristaltic pump. Electrophoresis was done at 100V for 16hrs. Differences in the concentration of ions, pH of the buffer and heat generation distorted the migration of DNA fragments. Thus, causing them to appear wobbly.

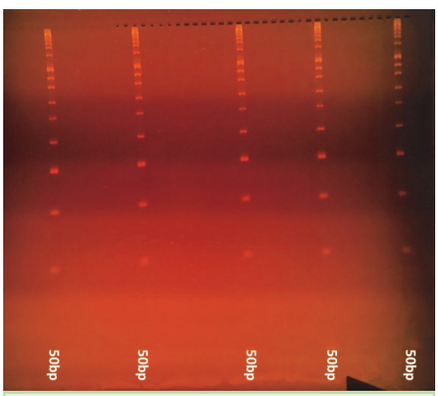

Figure 2b: Gel electrophoresis of samples using a peristaltic pump. Electrophoresis was done at 100V for 16hrs. Buffer circulation with the pump helped to reduce differences in the concentration of ions and pH of the buffer. Therefore, less heat was produced. DNA migration is not distorted and fragments in each lane appear straight and well aligned.

The Kirkhouse Trust Training Grant Scheme: This scheme offers partial funding for scientists and students wishing to attend a training course. Further information can be found on the Kirkhouse Trust website.
To apply please email info@kirkhousetrust.org to request an application form.

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Laboratory hints and tips *by Ann Lonie*

pH Electrodes

Looking after your pH meter and probe (electrode) will ensure accurate measurements can be made and will prolong the life of your pH electrode.

Fig. 1: Storage bottle

Hints & Tips to help you get good pH measurements:

- Soak new electrodes before use. A 50/50 mixture of pH 4.0 buffer and saturated KCl (potassium chloride) electrode storage solutions should be used for this.
- Use fresh buffers for calibration.
- Temperature impacts electrode performance. Use temperature compensation, (see the pH meter manual for instructions), or keep all samples and standards at the same temperature.
- Calibrate frequently. If you have not used your pH electrode for a while, calibrate it before use.
- Keep the tip of your pH electrode moist. We recommend that you store your electrode in electrode storage solution (KCl/buffer as above). If storage solution is not available, use pH 4.0 buffer solution. Do not store electrode in distilled or deionized water this will cause ions to leach out and will make your electrode unreliable or useless.

Fig. 2: Soak electrode

Cleaning/Re-conditioning of Combination Electrodes

Electrodes can be cleaned with a mild detergent solution or a commercial glass cleaning solution (provided these are not strongly acidic). The electrode surface should be soaked in the cleaning agent until clean. Rinse and repeat as necessary.

If your electrode has become clogged, try these steps:

1. Soak in a 0.1 M HCl for 5 minutes.
2. Remove and rinse with water.
3. Place in 0.1 M NaOH for 5 minutes.
4. Remove and rinse with water.
5. Soak in pH 4.0 buffer for at least 10 minutes before use.

Things to avoid:

Storing the pH electrode in purified water (RO, DI, or distilled) will shorten the life of your pH electrode. This is because the reference cell has a high salt solution and placing the probe in purified water will cause the salt to diffuse out and water to go in. Storage solution maintains the salt concentration.

Any air bubbles in the pH bulb or by the junction need to be removed. Gently shake the pH electrode to displace the air bubble.

Do not expose to high temperatures (> 65 °C).

Salt crystals: Sometimes you will see white salt crystals on the electrode. You can rinse them off with water to remove the salt build up.

Congratulations to Emma Graham and her husband Jack on the birth of their son Harry on the 6th June 2016.