Student profile

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Bio data

Professional Master in selection and valorization of plant genetic resources from the University of Ouagadougou since 2013/ I am engineer of agriculture working at the Minister in charge of agriculture in Burkina Faso since 2014. I am currently student in MoBreed PhD program at the University of Abomey-Calavi (Republic of Benin)
Home supervisor: Pr Mahamadou SAWADOGO from University Ouaga 1 Pr Joseph KI-ZERBO
Host university: Pr Enoch G. ACHIGAN-DAKO from University Abomey-Calavi

Major publications

Crops of interest: Kersting's groundnut [*Macrotyloma geocarpum* (Harms) Maréchal & Baudet]

Kersting's groundnut belongs to the Fabaceae family and origin of sudanian zone of Benin and Togo (Akohoue et al., 2019). It has multiple uses, including animal forage, human food, soil fertility, medicinal and traditional needs (Tamini, 1995; Adu-Gyamfi et al., 2011); (Assogba et al. 2016). It is also a good source of protein and substancial incomes for rural population (Ayenan and Ezin, 2016). Unfortunately, Kersting's groundut has not benefitted from any major improvement or promotion programs despite its economic, agronomic and nutritional importance. As consequence, the production of the crop has been decreasing from year to year (Ayenan and Ezin 2016; Akohoue et al., 2019).

Summary of proposal

The low yield (500Kg/ha) and late maturity (4-5months after planting) have been identified to be some of the main constraints of Kersting's groundnut production. Both, yield and maturity times in Kersting's groundnut are affected by environment conditions (Tamini, 1995; Bampuori, 2007).
Relatively few genetic studies have been conducted on the population structure of *Macrotyloma geocarpum* and genetic diversity among and within cultivars.
In order to have an accuracy selection of superior landraces to involve in the future breeding programs and further studies, integrating of molecular markers and phenotypic traits known as genomic prediction approach should be implemented.

No study has attempted to report on kersting's groundnut performance in relation to its agronomic traits in MET experiments. In addition, no genetic improvement of Kersting's groundnut landraces have been done and need to be undertaken including phenotypic and QTLs mapping approaches.

The overall goal of this research is to investigate genetic selection of superior cultivars of Kersting's groundnut through genomic approach and QTLs association mapping.

Specifically, this research aims:

1. to identify and access to kersting's groundnut landraces grown by farmers, farmers' constraints and preferences to kersting's groundnut production,
2. to dissect the genetic architecture of important agronomic traits (yield, its associated traits, flowering and maturity times) in kersting's groundnut landraces by using genome wide association studies (GWAS),
3. to detect the potential candidate landraces to involve in the MET study and superior cultivars development program,
4. to identify the landraces with good adaptability and stability for yield and its associated traits, flowering and maturity times under multiple environments conditions,
5. to identify QTLs linked to yield, flowering and maturity traits using SNPs based genetic map

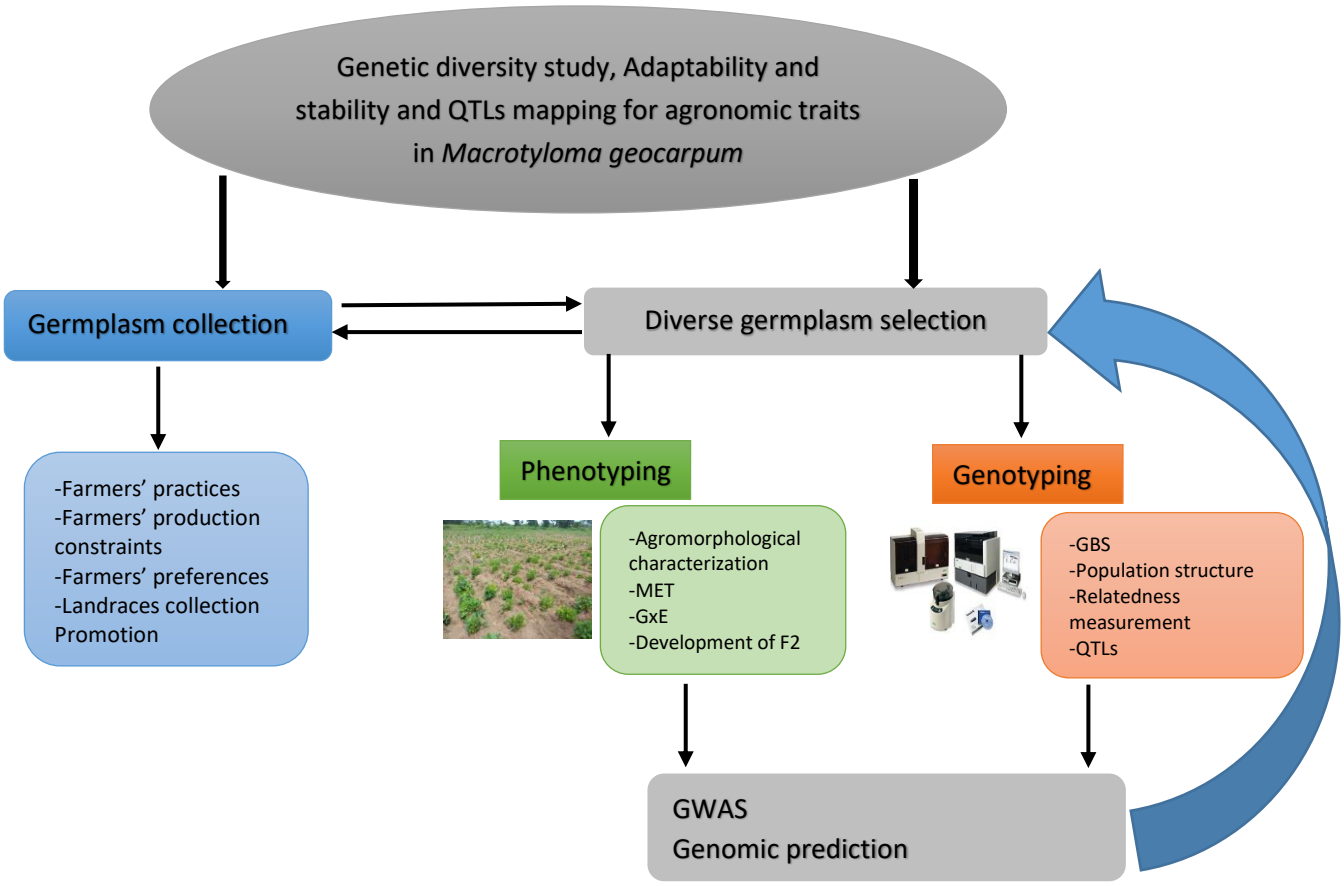
Obj 1: In order to access farmers' diversity, their knowledge, constraints and preferences, Participatory Rural Appraisal (PRA) is conducted in Burkina Faso and Ghana in 2018 using suitable tools like focus group discussion, and questionnaires techniques. Related information was collected from farmers sampled using snowball method and concerned: the status of kersting's groundnut in these locations and the prevailing stress, farmers' preferences for kersting's groundnut improvement and promotion.
Farmers's diversity is collected based on the geography and the characteristics of the seeds. R software version 3.5.3 is used for descriptive statistical analysis and ANOVA is performed for constraints and traits of interest in order to see the significance of the difference between agroecological zones.
Obj 2: The Kersting's groundnut landraces collected are completed by germplasm collected in Benin and Togo and phenotyped for development and agronomic traits. Twenty-three (23) agro morphological characters are recorded for each plant.
Molecular characterization is done using high throughput DArtSeq method of BeCa ILRI Hub Laboratory in Kenya. SNPs markers will be used to provide data for the estimate of genetic diversity. It concerns germplasm from Burkina Faso and Ghana used for morphological markers.
Obj 3: The Genomic Estimated Breeding Values (GEBVs) will be calculated to predict yield, flowering and maturity times traits in untested environments (year 2020) for landraces phenotyped in 2017, 2018 and 2019. Three models, 2 of Bayesian models (BL-A and BRR-A) and Genomic Best Linear Predictions (GBLUPs) will be performed using Bayesian generalized linear Regression (BGLR) package version 1.0.5. The superior cultivars will be selected using main agronomic traits and by incorporating these traits data and genomic data and by performing bioinformatics analysis. These cultivars will be used for multi-environment trials MET.

Obj 4: MET will be conducted in 2020 and 2021 in two locations of Benin (Central and Northern), of Burkina Faso (Western and central) and of Ghana (Upper West and Northern) main zones of Kersting's groundnut production. The soil analysis will be done and weather data (annual rainfall, daily temperature, relative humidity) will be collected on each site.

In each location, 16 cultivars (with different seed color) will be grown in randomly completed block design with three replications. Genotypes will be evaluated for agronomic traits (yield, 100 seeds weight flowering and maturity times). The choice of the superior cultivars will be based on their stability for yield, its associated traits, times flowering and maturation.

Obj 5: Six (6) parental lines (chosen based on their yield, 100 seeds weight and their flowering and maturation times) will be grown in 2019 in Benin using matting full-diallel design without self-pollination in order to develop the F1 family. The F2 families will be developed in 2020 and used to map QTLs associated with yield, its associated traits, flowering and maturity traits using SNPs markers.

A graphic abstract of the research proposal



Useful pictures



Personal comment about the Mobreed opportunity

I would like to thank coordinators of MoBreed program to establish this project which is very important for Africa in this context of climate changing and an expanding population. Thank for providing me this PhD scholarship. I hope that orphan crops will contribute to alleviate hunger and malnutrition from Africa.

Progress report

***Objective 1*:**

In order to access farmers' diversity, their knowledge, constraints and preferences, PRA has been conducted in Burkina Faso and Ghana in 2018 using suitable tools like focus group discussion, and questionnaires techniques. Related information was collected from 86 farmers sampled using snowball method and concerned: the status of kersting's groundnut in these locations, the prevailing stress, farmers' preferences for kersting's groundnut improvement and promotion. At the end of this investigation, 63 landraces were collected based on the geography and the characteristics of the seeds. The landraces were grouped in five different cultivars according to seed coat color. The main criteria used by farmers to choose the cultivars for production were the seed coat color, the organoleptic qualities and the uses categories. High yielding, drought and pulse beetle resistant cultivars were pointed out by farmers and would be the focus on for the future breeding program.

Objective 2:

The Kersting's groundnut landraces collected were completed by germplasm collected in Benin and Togo and phenotyped for development and agronomic traits. In total 346 accessions were planted at the centre (Savè) and the south (Sekou) of Benin in 2018 using 25x14 Lattice design with three replications per accession. Twenty-three (23) agro morphological characters were recorded for each plant.

Molecular characterization is going to be done using high throughput DArtSeq method of BeCa ILRI Hub Laboratory in Kenya. SNPs markers will be used to provide data for the estimate of genetic diversity. It concerns germplasm from Burkina Faso and Ghana used for morphological markers.

The superior cultivars will be selected by incorporating phenotypic data and genomic data and by performing bioinformatics analysis. These cultivars will be used for multi-environment trials MET.