

Genetic improvement of cowpea for resistance to *Striga* and *Alectra vogelii* in Nigeria



Federal University of
Agriculture, Makurdi
(FUAM).

Prof. Lucky Omoigui, UAM, Nigeria

Project team members

Mr Macsamuel Ugbaa

Mr Godspower Ekeruo

Ms Catherine Danmaigona Clement

Publications

Project locations



A field of the *Striga* resistant cowpea variety FUAMPEA 2, released in 2016.

PROJECT OVERVIEW

Background

In previous phase of the KT funded cowpea improvement projects at FUAM, two *Striga* resistant cowpea varieties were developed and released: FUAMPEA 1 and FUAMPEA 2. The project also identified breeding lines resistant to the parasitic weed *Alectra vogelii*, *Fusarium* wilt and aphids. The current project aims to consolidate on the progress made and complete the introgression of *Fusarium* wilt and aphid resistances into FUAMPEA 1 and FUAMPEA 2 using marker assisted selection. A further target trait for improvement is seed size, as large seeded varieties are prized by farmers and consumers.

Objectives

1. Identify molecular markers for resistance to *Alectra*, aphids and *Fusarium* wilt.
2. Introgress the aphid resistance gene into UAM elite varieties using marker-assisted backcrossing.
3. Introgress *Fusarium* wilt resistance into UAM elite varieties using marker-assisted backcrossing.



FUAMPEA 1, the *Striga* resistant cowpea variety released by FUAM in 2016.





Professor Omoigui in the KT lab in FUAM, 2013 (i); Ms Deborah Ayeni (former technician in the lab) in the screen house in 2016 (ii); FUAMPEA 1 seeds (iii); FUAMPEA 2 seeds (iv); example of selection of large seeded improved varieties (v).

PROJECT TEAM MEMBERS



Professor Lucky Omoigui
Principal Investigator, Federal University of Agriculture, Makurdi, and [Seed Systems Specialist](#) at the International Institute for Tropical Agriculture (IITA).

Professor Omoigui has led the KT-funded cowpea breeding programme in FUAM since its inception in 2010.



Mr Macsamuel Ugbaa
Co-PI & PhD Student
Mr Ugbaa, a current KT PhD scholar, became a Co-PI of the FUAM KT cowpea improvement programme in January 2020.



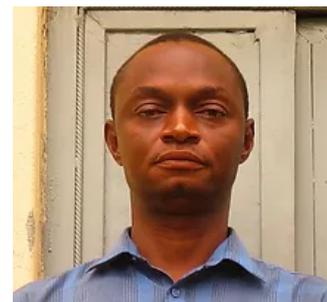
Mr Godspower Ekeru
Co-PI & PhD Student
Mr Ekeru became a Co-PI of the FUAM KT cowpea improvement programme in January 2020.



Ms Judith Ezugwu Ogechi
Lab Manager



Mr Simon Mnzughul
Research Technician



Mr Abiodun Ekundayo
Field Assistant



STUDENT PROJECTS

Identification and validation of molecular markers for *Alectra vogelii* resistance in cowpea (*Vigna unguiculata* (L.) Walp)

Mr Macsamuel Ugbaa

PhD in Plant Breeding and Genetics, Federal University of Agriculture Makurdi (FUAM), Nigeria, 2016-2021.

Supervisor: Professor Lucky Umoigui, FUAM, Professor L. L. Bello, FUAM.

Background

Alectra vogelii (also called yellow witch weed or cowpea witch weed) is an annual parasitic weed of legume crops in semi-arid areas of West Africa. Its most important host is cowpea, and is responsible for significant losses to production.

Project objectives

1. To assemble germplasm and evaluate for reaction to *Alectra*.
2. To carry out allelism test to identify sources of genetic resistance other than B301 (an *Alectra* resistant cowpea variety).
3. To generate segregating and mapping populations derived from B301 and Yamisra (susceptible to *Alectra*).
4. To phenotype segregating and mapping populations for reaction to *Alectra vogelii* using the pot culture technique inoculated with *Alectra* seeds.
5. To identify and validate molecular markers for *Alectra* resistance.



Mr Ugbaa working at the FUAM cowpea improvement molecular lab.

Progress to date

1. Elite, local and landraces cowpea germplasm screened for their reaction to *Alectra* using pot culture technique.
2. F2 population comprising 352 lines derived from B301 and Yamisra and phenotyped for reaction to *Alectra*.
3. 32 allele-specific molecular markers were used to screen the DNA of B301 and Yasmira for polymorphisms.
4. Bulk Segregant Analysis (BSA) performed on 10 homozygous *Alectra* resistant F2 lines, and 10 homozygous susceptible F2 lines.



An *Alectra* infested cowpea field in Northern Nigeria (i); A detached *Alectra* plant (ii); a successful cross between B301 (a cowpea variety resistant to *Alectra*) and Yasmira (an *Alectra* susceptible variety; iii); scoring plants in the screen house for their reaction to *Alectra* (iv).

Genetics of aphid resistance in cowpea [*Vigna unguiculata* (L.) Walp] using molecular and conventional breeding tools

Mr Godspower Ekeruo

MSc in Plant Breeding and Genetics, Federal University of Agriculture Makurdi (FUAM), Nigeria.
Supervisor: Dr Lucky Omoigui, FUAM, Prof. L. L. Bello

Background

Aphid (*Aphis craccivora* Koch) is an important insect pest for cowpea in Nigeria that can result in significant losses to production.

Project objectives

1. To identify cowpea genotypes with good sources of genetic resistance to aphid.
2. To elucidate inheritance pattern of aphids resistance in cowpea.
3. To identify molecular markers linked to the aphid's resistance gene to facilitate application of MAS in breeding programmes.

Achievements

1. Screening for reaction to aphids identified resistant and susceptible cowpea varieties.
2. TVu2876 (an aphid resistant variety) and Aloka local (a variety susceptible to aphids) were selected to generate F1 and segregating populations: resistance to cowpea aphids in TVu-2876 was found to be controlled by a major single dominant gene.
3. Two SSR markers, CP-171/172 and KAD-61, were identified to be associated with the aphid resistance gene.

Mr Ekeruo is introgressing the aphid resistance gene from TVu2876 into FUAMPEA 1 and FUAMPEA 2 for his PhD degree.



Mr Ekeruo loading a gel in the lab, 2017.



An aphid infested cowpea plant (i); Mr Ekeruo infesting plants with aphids to test for resistance (ii); the reaction of aphid resistant and susceptible cowpea varieties after the screen (iii); the FUAM aphid screen house (iv).

Genetics of *Fusarium* wilt (*Fusarium oxysporum* f. sp *trachiephilum*) resistance in cowpea (*Vigna unguiculata* (L.) Walp) using conventional and molecular approaches

Ms Catherine Danmaigona Clement

MSc in Plant Breeding and Genetics, Department of Plant Breeding and Seed Science, Federal University of Agriculture Makurdi (FUAM), Nigeria, awarded 2017.
Supervisors: Professor Lucky Omoigui, FUAM, Professor [Prof. L. L. Bello](#), FUAM.

Background

Nigeria is the largest producer and consumer of cowpea in the world but production is greatly constrained by several biotic and abiotic factors. *Fusarium*



wilt caused by *Fusarium oxysporum* f. sp *tracheiphilum* (Fot) is a serious disease of cowpea in Nigeria posing a major threat to cowpea production. Host resistance offers an effective and preferred solution for managing this disease in cowpea.



Ms Catherine Dabmaigona in the molecular lab in FUAM, 2015.

Project objectives

1. To identify potential genetic sources of resistance to cowpea *Fusarium* wilt.
2. To elucidate the inheritance pattern of *Fusarium* wilt resistance in cowpea.
3. To identify molecular markers closely linked to *Fusarium* wilt resistance in cowpea.

Achievements

1. The reaction of 60 cowpea genotypes to *Fusarium* for resistance and susceptibility was characterized by two methods (the seed soak method and the root deep inoculation method).
2. Three resistant varieties (TVu 134, TVu 410 and TVu 109-1) were identified as sources of resistance to *Fusarium* wilt in Nigeria.
3. Three sets of F2 populations developed between resistant and susceptible parents were characterized for resistance against *Fusarium* wilt using genetic analysis. *Fusarium* wilt resistant gene in genotypes TVu 134, TVu 410 and TVu 109-1 is conditioned by a single dominant gene.
4. A new molecular marker for *Fusarium* resistance, C13-16, was developed to facilitate breeding for resistance to *Fusarium* wilt in cowpea.

Ms Danmaigona is currently [completing a PhD degree](#) at the Agriculture & Life Sciences Texas A&M University, USA.



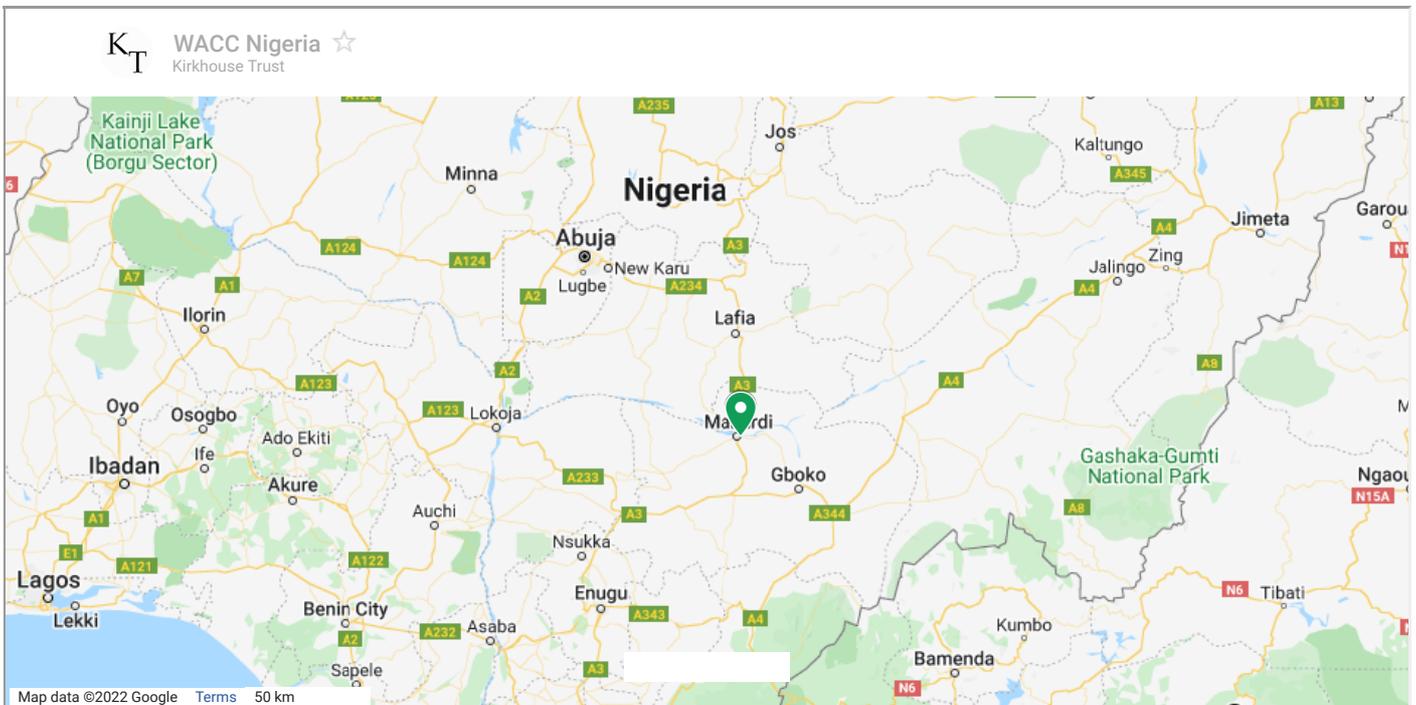
Reddish brown vascular discoloration of cowpea stems and roots infected with *Fusarium* wilt (i). The pot screening method to characterise reaction to *Fusarium* wilt (ii-v). uCowpea seeds were surface sterilized and planted in pots with sterile soil; 1 week after planting the seedlings were uprooted washed and roots were trimmed using scissors (ii). The seedlings with trimmed roots were soaked in a spore suspension (iii). The seedlings were replanted in sterile soil, watered and fertilised (iv). After 9 weeks this screen distinguishes resistant and susceptible cowpea varieties to *Fusarium* wilt (v; arrow points to a susceptible variety).

PUBLICATIONS

- M.S. Ugbaa, L.O. Omoigui, B.S. Gowda and M.P. Timko. (2021). SSR markers associated with *Alectra vogelii* resistance gene in cowpea [*Vigna unguiculata* (L.) Walp]. World Researchers Association- Research Journal of Biotechnology 16: 94-101. doi: <https://doi.org/10.25303/169rjbt94101>
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- Omoigui, L.O., Arrey, M.O., Danmaigona, C.C., Ekeruo, G. and Timko, M.P., 2019. Inheritance of resistance to Cercospora leaf spot disease of cowpea [*Vigna unguiculata* (L.) Walp]. Euphytica, 215: 1-12.
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- Omoigui, L.O., Ekeuro, G.C., Kamara, A.Y., Bello, L.L., Timko, M.P. and Ogunwolu, G.O., 2017. New sources of aphids [*Aphis craccivora* (Koch)] resistance in cowpea germplasm using phenotypic and molecular marker approaches. Euphytica 213: 1-15.
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- M.S. Ugbaa, L.O. Omoigui, B.S. Gowda and M.P. Timko. (2021). SSR Markers Associated with *Alectra vogelii* Resistance Gene in Cowpea (*Vigna unguiculata* (L.) Walp). *World Researchers Association - Research Journal of Biotechnology*. 16(9): 94-101

PROJECT LOCATIONS



Main Research Station, Makurdi, Nigeria

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