

A WAY TO STRENGTHEN THE ROLE OF COWPEA IN WEST AFRICA

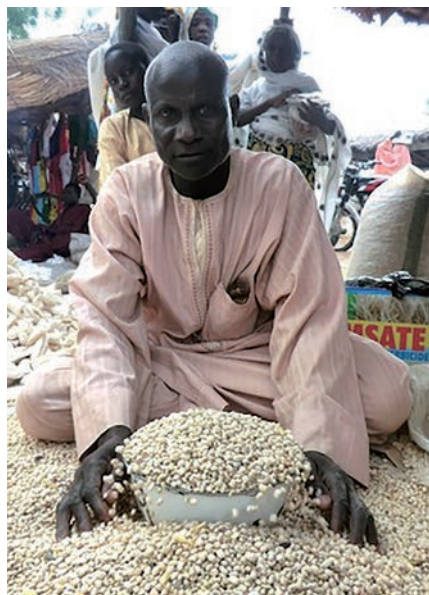
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Satoru Muranaka holds a PhD from the University of Tsukuba, Japan. Dr. Muranaka worked as a plant physiologist at the Arid Land Research Center, Tottori University, Japan, and the International Institute of Tropical Agriculture, Nigeria. Currently, he is a researcher of JIRCAS tackling the evaluation utilization of genetic resources of cowpea and yam, important regional crops of West Africa.

ABSTRACTS



In many African countries, there are many regionally and traditionally important crops such as sorghum, millet, yam, cowpea, banbara groundnuts, banana, and plantain, etc. They possess various unique characteristics that enable them to become suitable to regional and local environments and cultures; and they play crucial roles in the farm households. There are rational reasons for and advantages of cultivating those crops traditionally and continuously. These crops hold great potential to bolster the livelihoods of smallholder farmers and to benefit local communities in terms of household food security, nutritional supply, economic benefits, soil and ecosystem health, cultural values, and diversification of regional agriculture systems.

Cowpea [*Vigna unguiculata* (L.) Walp.] is a major grain legume widely cultivated in most tropical regions around the world, especially in a wide range of agro-ecological zones in West Africa. The crop's importance is attributed to its favorable characteristics such as tolerance to drought and low soil fertility, nitrogen (N)-fixing ability, and adaptability to different cropping systems,

which provide resilience to the agricultural systems under severe and unstable growing environments of the region, particularly for small-scale farmers who have limited land and resources (Coulibaly and Lowenberg-DeBoer 2002).

Also, as a grain legume with rich protein and micronutrient contents, cowpea can supplement staple crops (cereals and tubers) for more nutritionally balanced diets in this region. It serves as a key protein source, especially where consumption of animal proteins is precluded because of inaccessibility, poverty or dietary preferences. At the same time, it is also an important cash crop that help farmers meet required expenditures, such as for additional food, agricultural inputs, clothes, medications, school fees, etc. Sold cowpea grains greatly contributed to the regional economy via well-linked cowpea value chain in West Africa. According to FAO (2007-2009 data), cowpea generated an estimated 2 billion USD in annual revenue.

Although the yield factor remains as the primal target in our on-going cowpea breeding programs, "value-addition" should also brought into the view for future development, focusing on the amplification of the roles and utilization of cowpea in rural livelihood and regional markets through enhanced income generation, food security and balanced nutritional supply in the region. Furthermore, cowpea's wide genetic diversity in various quality-related traits can be the key to value-addition in cowpea and its products that could meet various local preferences and cultural demands. However, the fundamental scientific information that form the basis for innovation generation and breeding strategies for value-addition in cowpea is currently lacking.

Realizing this challenge, JIRCAS has been implementing the "EDITS-Cowpea" project since 2011 in Nigeria, the world's largest producer and consumer of cowpea, in collaboration with the International Institute of Tropical Agriculture (IITA), to generate the necessary scientific information and to provide more insights that will promote value-addition in cowpea improvement for the region. The project aims to 1) identify key characteristics with a view of improving grain quality and nutritional value, 2) select appropriate breeding materials for further improvement, 3) evaluate environmental factors affecting grain quality, and 4) develop useful techniques for rapid and simple evaluations of grain quality.

Under the project, we have identified wide genetic diversity in physical, nutritional/ antinutritional, and functional properties of cowpea grain, and found low associations among these properties (Muranaka *et al.* 2015). This finding suggests the possibility of introgressing favorable characteristics from the genetic resources to develop new varieties which match market and consumer preferences and enhance the nutritional and commercial values of the grain. In addition to the identified potential genetic resources, other scientific information obtained from the EDITS-Cowpea project, such as several developed tools for rapid evaluation of grain physical characteristics and protein contents; the suggested grain characteristics that influence market price; and the environmental factors that affect grain quality, will link the primal elements needed for grain quality improvement towards value-addition and facilitate the development of breeding strategies for value-

added cowpea.

In the near future, with the expected market expansion arising from economic growth in Africa, cowpea varieties that meet various demands and preferences of markets and consumers will be highly required. On the other hand, farmers will not select the variety even it has a high market price, if it is not equipped with suitable traits, and has low productivity and environmental adaptability to the target agriculture systems. To enable cowpea to respond to diverse requirements from various delivery destinations, JIRCAS is advancing its research activities on cowpea in order to strengthen the phenotyping capacity, which can be an important gateway to further large-scale exploration of useful genetic resources, effective selection in breeding procedure, and further development of molecular tools for breeding programs. It will eventually facilitate the dissemination of new suitable cowpea varieties and farmers' options, thus maximizing the productivity of the target environments and cropping systems.

Agricultural diversification and innovation should be defined and suited for each location to achieve sustainable production and food security. From this viewpoint, regionally important crops should be worthy of attention. Still, there is a large gap existing between the potential role of these crops and the low levels of investment they have received. The outputs of JIRCAS's collaborative researches on regionally and traditionally important crops are expected to advance our understanding for further development and utilization.


KEYWORDS

Regional crops, cowpea, genetic diversity, quality, value-addition

REFERENCES

Coulibaly, O. and J. Lowenberg-DeBoer, 2002: Challenges and opportunities for enhancing sustainable cowpea production. Ibadan: IITA, pp. 351–366.

Muranaka, S., M. Shono, T. Myoda, J. Takeuchi, J. Franco, Y. Nakazaw, O. Boukar, and H. Takagi, 2015: Plant Genetic Resources: Characterization and Utilization, doi:10.1017/S147926211500009X




A Way to Strengthen the Role of Cowpea in West Africa

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Agriculture in Africa




- Agricultural sector:
 - Employ 65-70 % of workforce
 - Generate 1/3 of GDP
- Food importation:
 - 35 billion USD annual
- Uncultivated arable land
 - 60% of global total
- Agricultural producers:
 - Most of them are poor
- Agricultural incomes:
 - Rose by <1% per year per capita
 - Success in Ethiopia and Kenya

➔ Small-scale farmers is a key for agricultural growth

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Regional crops

Traditionally important crops in West Africa



Sorghum Millet Yarn Cowpea Bambara nuts

hold great potential to bolster the livelihoods and economics

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Regional crops


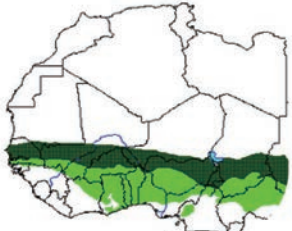
Play critical role in the region

- Diversifying cropping system
- Conserving soil and soil fertility
- Reducing food importation
- Broadening the food base
- Enhancing nutritional status
- Meeting regional demands / cultures
- Increasing household cash income

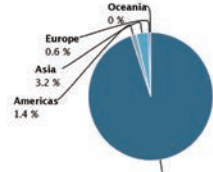
➔ Resilience of system
➔ Nutrition and Health
➔ Quality of life

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Cowpea: Major Legume in West Africa

Mainly cultivated in drier regions




Production of cowpea (Average 1998-2013, FAO stat)

- Africa 94.9%
- Asia 3.2%
- Americas 1.4%
- Europe 0.6%
- Oceania 0%

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Cowpea: Major Legume in West Africa






- Adaptability to local environments
 - Tolerant to drought
 - Tolerant to low soil fertility
 - N-fixing ability
 - Diverse maturity groups
- Nutritional and economic values
 - Rich in protein and micronutrients
 - Protein-rich fodder for animals
 - High marketability

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For Small-Scale Farmers in Drier Regions

- Short and unstable rainy season
- Limited land availability
- Low soil fertility
- Low investment



Serves as:

- Food and nutritional source
- Cash income source
- Risk-reducing option

Advantage: Wide Genetic Diversity

Rich genetic resources with wide genetic diversities in various traits


- Agronomic traits
 - Grain and fodder yields and balances
 - Maturity, Plant type,
 - Resistances to biotic / abiotic stresses
- Grain quality-related traits
 - Grain size, texture and color
 - Cooking properties
 - Nutritional / antinutritional components

Value-addition: Amplifying the Role of Cowpea


Diverse grain quality-related traits

- Increment of consumption
- Better nutritional supply
- Activation of marketing/trading
- Enhanced food processing



Missing scientific information

- What are the key traits preferred by consumers?
- Which genetic material has the target key traits?
- Who needs the varieties?
- Where can we grow high-value cowpea?
- How are quality-related traits evaluated?



For the Value-Addition in Cowpea


"Strategic approach to develop value-added cowpea varieties with higher food and nutrition quality" **EDITS-Cowpea**

To answer the questions:

- What are the key traits preferred by consumers?
 - ▶ "Needs" and "Preference"
- Which genetic material has the target key traits?
 - ▶ "Diversity" and "Characteristics"
- Where can we grow high-value cowpea?
 - ▶ "Environmental effects"
- How are quality-related traits evaluated?
 - ▶ "Tools" and "Information"


"Needs" and "Preference"

- What are the key traits preferred by consumers?



For Nigerian markets:


- Key quality traits influence price
- Market recognition of "variety"
- Demand and supply
- Market integration



Chien et al. (2015) "Variety name" in determination of cowpea retail price in Nigeria: Providing information about unobserved quality characteristics? 2014 NNGR: 238-241 (in Japanese)

"Diversity" and "Characteristics"

- Which genetic material has the target key traits?



Wide genetic diversity

- Grain size and color
- Crude protein, Micronutrients
- Free sugar, Phytic acid,
- Fibers, Polyphenol, Cooking time

Narrow genetic diversity

- Fatty acid contents / composition
- Amino acid composition


Positive correlations

- Crude protein, Fe, and Zn

Muranaka et al. (2015) Genetic diversity of physical, nutritional and functional properties of cowpea grain and relationships among the traits. PGR, doi: 10.1017/S147252115000099X

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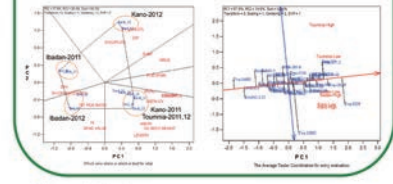
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"Environmental factors"

- Where can we grow high-quality cowpea?



- Relationship among environments and quality-related traits
- Low level of interaction between genotypes and environments




Muranaka et al. (2014) Evaluation of environmental effects on yields and quality traits in cowpea, Jpn Crop Science Conference, Poster presentation

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"Tools" and "Information"

- How are quality-related traits evaluated?



- Estimation of grain N content using IR
- Image analysis for grain size / stability
- RVA for starch characterization
- Data entry supporting system

➔ Technical manuals




Muranaka et al. (2015) Application of near- and mid- refractive spectroscopy for the estimation of nitrogen content in the grain of cowpea. J. Biol. Food. Sci. Res. 4(2):16-24

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For Value-addition in Cowpea

Primal elements essential for the development of cowpea varieties with "higher values"


- ➔ promote the development of breeding strategies for value-added cowpea



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Enough?

- Who needs the varieties?



Especially for small-scale farmers, cowpea is not only a cash crop.

- High grain and fodder productivity
- Emergency food during hungry period
- Adapted to the cropping system
- Meet their own needs and preferences


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Stepping Forward

Requires deeper understanding of :

- Genetic resources
- Farmers' needs
- Cropping systems

to really strengthen the role of cowpea




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Stepping Forward

Sites: Burkina Faso

- World's 3rd largest cowpea producer
- Increasing consumption
- Exporter to neighboring countries
- Three agro-ecological zones




Activities:

- Characterization and exploration of useful genetic resources
- Explication of genotypes x cropping systems
- Understanding the role of cowpea and farmers' needs

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Linking Players



Genetic resources

Crop improvement

Consumers

Producers

➔ Providing better resource utilization options for the cropping system and the peoples

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With Strengthened Role

Through its role as a regional crop,



cowpea can contribute to improve the farmers' livelihood and provide more resilience under challenging condition

➔ Quality of development

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Partnership – A Key to Success



National Res. Inst. International Res. Inst.

Markets

Extension agents

Research Capacities in Japan

Farmers

ITTA
Research to Nourish Africa

JIRCAS
JAPAN

東京大学
THE UNIVERSITY OF TOKYO

東京農業大学
東京農業大学

IBRC and more...

FNFI
COO

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Our Team Members



Dr. H. Takagi (PL)

Mr. G.M. Bala

Ms. O. Olaleye

Thank You

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