Alliance

Bioversity International

CIAT
International Center for Tropical Agriculture
Since 1967 Science to cultivate change

Enhancing access to genetic resources for climate change adaptation in Kenya, Uganda and Tanzania

Seed Catalogue of Best Perfoming Varieties of Beans and Finger millet in Hoima Uganda

Gloria Otieno[1], Tobias Recha[1], Carlo Fadda[2], John Mulumba[3], Joyce Adokorach[3], Jasper Ahumuza[4], Ronald Kakeeto[4], Godfrey Kairagura[5]

[1] Alliance of Bioversity International and CIAT, Kampala Uganda

[2] Alliance of Bioversity International and CIAT, Nairobi Kenya

[3] Plant Genetic Resource Centre of the National Agricultural Research Organization, Uganda

[4] Bulindi Zonal Agricultural Research and Development Institute of the National Agricultural Research Organisation (NARO-BUZARDI)

[5] Hoima Community Seed Bank

CGIAR Research Program on Climate Change, Agriculture and Food Security — CCAFS

The International Treaty on Plant Genetic Resources for Food and Agriculture

KIT Royal Tropical Institute

CGIAR Research Program on Grain Legumes and Dryland Cereals

Hivos people unlimited

Food and Agriculture Organization of the United Nations

Sustainable Agriculture and Natural Resource Management Africa — SANREM AFRICA

NARO

NWO Netherlands Organisation for Scientific Research

PELUM Association

The Alliance of Bioversity International and the International Center for Tropical Agriculture (CIAT) delivers research-based solutions that address the global crises of malnutrition, climate change, biodiversity loss, and environmental degradation.

The Alliance focuses on the nexus of agriculture, nutrition and environment. We work with local, national, and multinational partners across Africa, Asia, and Latin America and the Caribbean, and with the public and private sectors and civil society. With novel partnerships, the Alliance generates evidence and mainstreams innovations to transform food systems and landscapes so that they sustain the planet, drive prosperity, and nourish people in a climate crisis.

The Alliance is part of CGIAR, the world's largest agricultural research and innovation partnership for a food-secure future dedicated to reducing poverty, enhancing food and nutrition security, and improving natural resources.

www.bioversityinternational.org www.ciat.cgiar.org www.cgiar.org

Citation: Otieno G, Recha T, Fadda C, Halewood M, Mulumba J, Adokorach J, Ahumuza J, Kakeeto R and Kairagura G (2020), Enhancing access to genetic resources for climate change adaptation in Kenya, Uganda and Tanzania: *Seed Catalogues of Best Perfoming Varieties of Beans and Finger millet in Hoima Uganda*.

Design and layout: Luca Pierotti

Cover Photo: Display of different bean varieties during seed fair in Hoima Uganda
Credit: Alliance of Bioversity International and CIAT/G. Otieno

ISBN: 978-92-9255-197-1

Via dei Tre Denari 472/a
00054 Maccarese
Rome, ITALY

https://www.bioversityinternational.org/

Acknowledgments

We acknowledge and appreciate the contributions, support and collaboration of Hivos, Particpatory Ecological Land Use Management (PELUM Uganda), the Plant Genetic Resource Center of the National Agricultural Research Organization of Uganda (NARO-PGRC); Bulindi Zonal Agricultural Research and Develpment Institute of the National Agricultural Research Organisation (NARO-BUZARDI); the Genetic Resources Research Institute of Kenya Agricultural and Livestock Research Organization (GeRRI-KALRO), Tanzania Plant Genetic Resource Centre (TPGRC), Sustainable Agriculture and Natural Resource Management Africa (SANREM-AFRICA) and Farmers from the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) sites in Hoima Uganda and Nyando Kenya and Farmers from Dodoma and Singida Tanzania.

We would like to thank the Netherlands Organization for Scientific Research (NWO) and the FAO International Treaty's Benefit-sharing Fund for funding this work. This work was implemented as part of the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS), which is carried out with support from the CGIAR Trust Fund and through bilateral funding agreements. For details please visit https://ccafs.cgiar.org/donors. The views expressed in this document cannot be taken to reflect the official opinions of these organizations.

We acknowledge Joseph Mugah for editing this catalogue and Luca Pierotti for the design and layout.

Introduction

Food and nutritional security of resource poor farmers globally is increasingly under a serious threat of climate change. In Kenya, Tanzania and Uganda, agricultural production rates are low, exacerbated by frequent erratic rainfall and droughts due to climate change. The homogenization of agriculture to single crops or varieties in hope of higher yields, coupled with the associated loss of biodiversity, has further decreased the resilience of resource-poor farmers. The loss of genetic diversity in farmers' custody has greatly narrowed the gene pool from which to depend on. In order to help them adapt to climate change, a project called "Promoting Open Source Seed Systems for Beans, Millet and Sorghum for Climate Change Adaptation" funded by the Benefit-sharing Fund (BSF) established under the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) was implemented in Kenya, Uganda and Tanzania. This project increased the availability and diversity of climate-smart varieties of four important crops, namely beans, forage legumes, finger millet and sorghum through testing, breeding and production of high quality seeds and increasing access to a wider range of locally adapted varieties

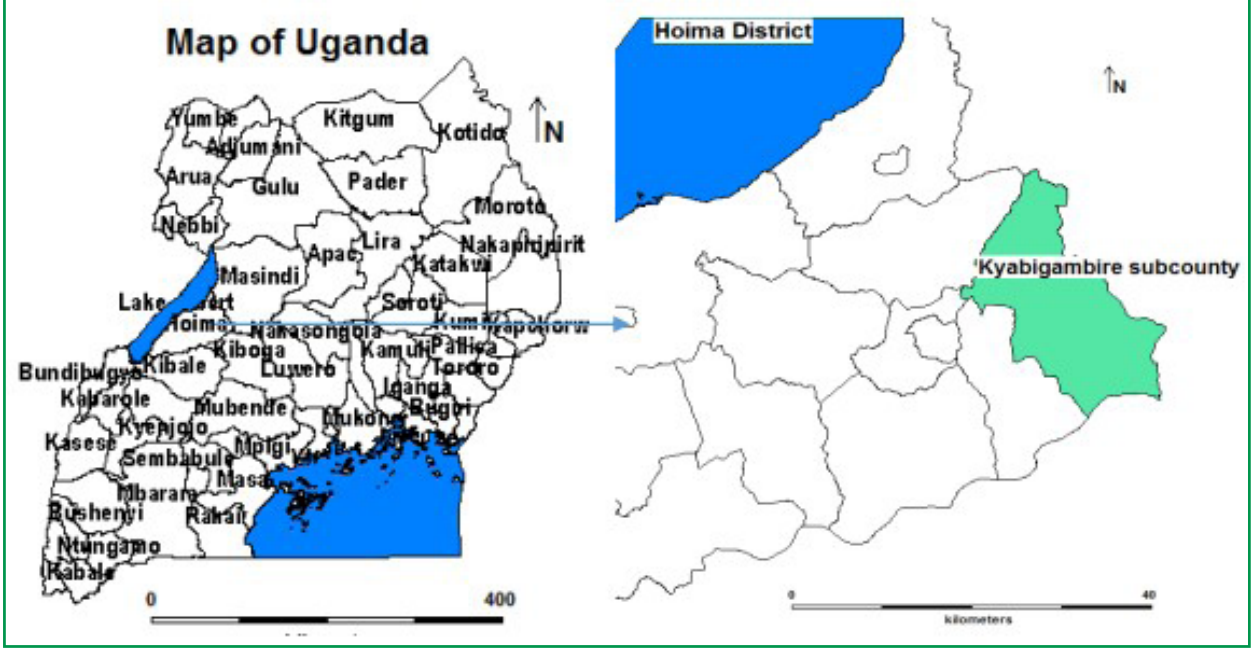
In Uganda 99 beans and 147 finger millet accessions were locally sourced and others shared with the Plant genetic resource center from Kenya and Tanzania national gene banks through Standard Material Transfer Agreement (SMTA) to be used in the project. They were multiplied at Bulindi Zonal Agricultural Research and Development Institute (BUZARDI) for two seasons of 2016 and 2017. Out of these, 34 beans and 44 millet accessions performed well and were therefore given to 250 farmers for crowdsourcing trials during the cropping seasons of 2018 and 2019. On-station trials were also established for breeder's evaluation and participatory varietal evaluation. The high performing varieties were later subjected to organoleptic testing where 7 beans and 7 finger millet accessions were selected. This catalogue presents the best and top selected varieties of beans and finger millet that can be disseminated in larger areas and also improved further through breeding.

The catalogue provides a summary of soils and climatic conditions in Hoima, and agronomic attributes and nutritional content of the selected varieties of beans and finger millet. The agronomic attributes were collected during trials. For beans, they include bean type (whether bushy or climbing type), days to maturity, yield potential, seed color and seed shape. For Fingermillet, they included number of spikelets/ fingers, color of spikelet/fingers, days to maturity, yield potential and grain color.

The nutritional content of the selected varieties was done at the Food and Nutritional Evaluation Laboratory (FANEL-BeCa ILRI Hub) in Nairobi Kenya. The nutritional evaluation included determination of moisture content, proteins, ash, fat, crude fibre, carbohydrate, iron, zinc, calcium and total phenolics.

Soils and climate information of Hoima, Uganda

Figure 1. Map of the Kyabigambire Sub-county project site in Hoima, Uganda



Hoima is located in western Uganda along Latitude 1.4273554°S and Longitude 31.3484448°E with an altitude range of 900 to 1500 m and a land area of 3,664 km². The area falls under a sub-humid climate and has an average annual rainfall of 1400 mm, with bimodal peaks in April to May and August to November. Hoima experiences maximum and minimum temperatures of about 35 and 14°C respectively. Recent climate challenges have included shifting and shortening of seasons, longer dry seasons and erratic rainfall patterns. The soils are mainly dark-red clay loams characterized by above-average fertility. d).

Fingermillet Catalogue

Finger millet pictures collage.

Credit: Alliance of Bioversity International and CIAT/ T.Recha

Documented importance and nutritional profile of fingermillet

Finger millet is one of the crops that could contribute to achieving food and nutrition security in Uganda and other African countries because of its drought-tolerant characteristics. It has small grains that are rich in protein and micro-nutrients such as calcium, iron, and zinc. It is very important especially because it is used as a complementary food in most African communities. Finger millet may also contain polyphenols, which are given in this catalogue as total phenolics. These are health-promoting components. They are said to have a protective effect in acute and chronic diseases like obesity, neurodegenerative diseases, type 2 diabetes, and cardiovascular diseases. Some of them may affect nutrient availability from food to the body. However, processing methods like fermentation and germination may reduce these negative properties. Finger millet is also high in calcium, zinc phosphorus, iron and manganese and is important as a gluten free cereal.

Variety Name: GBK-000920

Country of origin: Kenya

The seed colour is brown.

Agronomic Characteristics

- It produces up to eight spikelets/fingers.
- The colour of spikelets/fingers is brown.
- It takes 113 days to mature, so it is considered a medium-maturing variety.
- It can yield up to 2180 kg/ha (24 90-kg bags), therefore it is a high-yielding variety.

Nutritional Value	Dry weight basis	Reported Averages
Moisture content	9.03%	7.15-12.8%
Protein	10.55%	6.2-12.3%
Ash	0.26%	0.47-4.40%
Fat	1.16%	1.3-5.0%
Crude fibre	11.72%	2.2-12.0%
Carbohydrate	60.78%	60.9- 83.3%
Iron	8.04 mg/100 g	0.5-18.6 mg/100 g
Zinc	2.30 mg/100 g	0.7-3.1 mg/ 100 g
Calcium	389.96 mg/100 g	20-398 mg/100 g
Total Phenolics (Health promoting compounds)	0.1-368 mg/100 g	0.1-368 mg/100 g

Source of reported averages: Ramashai et al. (2019); Leder (2004); Chandra et al. (2016).

Further information

- High in protein
- About average in iron content
- Good for preparing *Obushera*[1]

[1] Mubiru, D., Recha, T and Otieno, G, E. (2019) Sensory Evaluation Field Report for Finger Millet and Bean Products, Hoima Uganda. Field Work report from 6th to 12th September 2019 Rome, Alliance of Bioversity International and CIAT.

Variety Name: TZA 1693

Country of origin: Tanzania

The seed colour is pale cream.

Agronomic Characteristics

- It produces up to eight spikelets/fingers
- The colour of spikelet/fingers is white.
- It takes 109 days to mature, therefore it is considered a medium-maturing variety.
- It can yield up to 2100 kg/ha (23x90-kg bags), therefore it is a high-yielding variety.

Nutritional Value	Dry weight basis	Reported Averages
Moisture content	9.85%	7.15-12.8%
Protein	8.65%	6.2-12.3%
Ash	0.0218	0.47-4.40%
Fat	0.0119	1.3-5%
Crude fibre	11.78%	2.2-12.0%
Carbohydrate	66.38%	60.9-83.3%
Iron	5.93 mg/100g	0.5-18.6 mg/100g
Zinc	2.51 mg/100g	0.7-3.1 mg/100g
Calcium	431.81 mg/100g	10-398 mg/100g
Total Phenolics (Health promoting compounds)	8.16 mg/100g	0.1-368 mg/100g

Source of reported averages: Ramashai et al. (2019); Leder (2004); Chandra et al. (2016).

Further information

- High in protein
- High in zinc and calcium
- Good for preparing Kalo and *Obushera*[1]

Variety Name: TZA 1701

Country of origin: Tanzania

The seed colour is brown.

Agronomic Characteristics

- It produces up to seven spikelets/fingers.
- The colour of spikelet/fingers is brown.
- It takes 113 days to mature, so it is considered a medium-maturing variety.
- It can yield up to 4810 kg/ha (53 90-kg bags), therefore it is a very high-yielding variety.

Nutritional Value	Dry weight basis	Reported Averages
Moisture content	10.25%	7.15-12.8%
Protein	11.43%	6.2 – 12.3%
Ash	2.79%	0.47- 4.4 %
Fat	1.26%	1. 3- 5%
Crude fibre	11.24%	2.2 - 12.0%
Carbohydrate	63.03%	60.9-83.3%
Iron	6.14 mg/100 g	0.5-18.6 mg per 100 g
Zinc	2.60 mg/100 g	0.7-3.1 mg per 100 g
Calcium	392.25 mg/100 g	20-398 mg per 100 g
Total Phenolics (Health promoting components)	14.87 mg/100 g	0.1-368 mg/100 g

Source of reported averages: Ramashai et al. (2019); Leder (2004); Chandra et al. (2016)

Further information

- High in protein and minerals especially iron, zinc, and calcium
- Relatively low in phenolics, meaning good mineral availability to the body
- Good for preparing local food products such as *Kalo*, hot porridge, *Malwa*, *Kwete*, and *Obushera*[1]

Variety Name; TZA 3676

Country of origin: Tanzania

The seed colour is brown.

Agronomic Characteristics

- It produces up to seven spikelets/fingers
- The colour of spikelet/fingers is pale brown.
- It takes 112 days to mature; therefore, it is considered a medium-maturing variety.
- It can yield up to 4410 kg/ha (49x90-kg bags); therefore, it is a very high-yielding variety.

Nutritional Value	Dry weight basis	Reported Averages
Moisture content	10.90%	7.15-12.8%
Protein	11.04%	6.2 – 12.3%
Ash	1.54%	0.47-4.4%
Fat	1.60%	1.43- 5%
Crude fibre	11.38%	2.2 - 12.0%
Carbohydrate	63.54%	60.9-83.3%
Iron	5.42 mg/100g	0.5-18.6 mg/100g
Zinc	2.80 mg/100g	0.7-3.1mg/100g
Calcium	511.18 mg/100g	10-348 mg/100g
Total Phenolics (Health benefiting compounds)	6.98 mg/100g	0.1-368mg/100g

Source of reported averages: Ramashai et al. (2019); Leder (2004); Chandra et al. (2016).

Further information

- Rich in Protein
- Very rich in calcium (1.5 times higher than average)
- High in zinc
- Low in phenolics, implying greater availability of minerals to the body
- Good for preparing *Malwa*[1]
- Good for complementary feeding by pregnant and lactating mothers.

Variety Name: TZA 3934

Country of origin: Tanzania

The seed colour is dark brown.

Agronomic Characteristics

- It produces up to six spikelets/fingers.
- The colour of spikelet/fingers is brown.
- It takes 108 days to mature, so it is considered a medium-maturing variety.
- It can yield up to 4180 kg/ha (46 90-kg bags), therefore it is a very high-yielding variety.

Nutritional Value	Dry weight basis	Reported Averages
Moisture content	10.45%	7.15-12.8%
Protein	10.99%	6.2-12.3%
Ash	2.67%	0.47-4.40%
Fat	1.67%	1.3-5%
Crude Fibre	11.44%	2.2-12.0%
Carbohydrate	62.79%	60.9-83.3%
Iron	4.89 mg/100 g	0.5-18.6 mg/100 g
Zinc	2.56 mg/100 g	0.7-3.1 mg/100 g
Calcium	400.67 mg/100 g	20-398 mg/100 g
Total Phenolics (Health promoting compounds)	5.94 mg/100 g	0.1-368 mg/100 g

Source of reported averages: Ramashai et al. (2019); Leder (2004); Chandra et al. (2016).

Further information

- High in protein because it is close to the documented maximum
- High in calcium
- Low in total phenolics, therefore increased minerals available to the body
- Good for preparing *Kalo*, *Kwete* and *Obushera*[1]

Variety Name: UNGB 2321

Country of origin: Uganda

The seed colour is dark cream.

Agronomic Characteristics

- It produces up to eight spikelets/fingers.
- The colour of spikelet/fingers is white.
- It takes 131 days to mature, considered late-maturing variety
- It can yield up to 2880 kg/ha (32 90-kg bags), therefore it is a high-yielding variety.

Nutritional Value	Dry weight basis	Reported Averages
Moisture content	9.53%	7.15-12.8%
Protein	7.62%	6.2 – 12.3%
Ash	3.31%	0.47- 4.4%
Fat	1.38%	1.3- 5%
Crude fibre	8.54%	2.2 - 12.0%
Carbohydrate	69.62%	60.9-83.3%
Iron	8.29 mg/100g	0.5-18.6mg per100g
Zinc	2.20 mg/100g	0.7-3.1 mg per 100g
Calcium	519.53 mg/100g	20-398 mg per 100g
Total Phenolics (Health Promoting compounds)	8.72 mg/100g	0.1-368 mg/100g

Source of reported averages: Ramashai et al. (2019); Leder (2004); Chandra et al. (2016)

Further information

- It is high in minerals, especially calcium.
- Good for preparing *Kalo*, hot porridge, *Malwa* and *Obushera*[1]
- Low in total phenolics implying high mineral availability to the body

Variety Name: UNGB 4146

Country of origin: Uganda

The seed colour is dark brown.

Agronomic Characteristics

- It produces up to seven spikelets/fingers.
- The colour of spikelet/fingers is brown.
- It takes 114 days to mature, therefore it is considered a medium-maturing variety.
- It can yield up to 4150 kg/ha (46 90-kg bags), therefore it is a very high-yielding variety.

Nutritional Value	Dry weight basis	Reported Averages
Moisture content	10.27%	7.15-12.8%
Protein	10.71%	6.2-12.3%
Ash	3.29%	0.47-4.40%
Fat	1.23%	1.3-5%
Crude fibre	13.72%	2.2-12.0%
Carbohydrate	60.78%	60.9-83.3%
Iron	3.99 mg/100 g	0.5-18.6 mg/100 g
Zinc	2.72 mg/100 g	0.7-3.1 mg /100 g
Calcium	325.89 mg/100 g	10-398 mg/100 g
Total Phenolics (Health Promoting compounds)	6.88 mg/100 g	0.1-368mg/100 g

Source of reported averages: Ramashai et al. (2019); Leder (2004); Chandra et al. (2016).

Further information

- High in protein
- High in ash, therefore could be high in minerals
- High in zinc
- Low in total phenolics, which could imply high mineral availability to the body.
- Good for preparing *Malwa*, *Kwete* and *Obushera*[1]

Bean Catalogue (Hoima)

Documented importance and nutritional profile of beans

Eating beans are a cost-effective way of supplying proteins to the diet. Among the health benefits attributed to beans are: high content of proteins, dietary fibers, low saturated fat content, vitamins, minerals, and phytochemicals (chemicals that occur naturally in plants). Beans also contain polyphenols, which are presented here as total phenolics with health benefits such as anti-diabetic, anti-inflammatory, anti-mutagenic, and they also contain a high amount of anti-oxidants.

Variety Name: Kaitabahuru (Local Variety)

Country of origin: Uganda

The seed colour is light purple with white dots.

The seed shape is kidney type.

Agronomic Characteristics

- This is a moderate climber.
- It takes 85 days to mature, so it is considered a medium-maturing variety.
- It can yield up to 1250 kg/ha (14 90-kg bags), therefore it is a medium-yielding variety.

Nutritional Value	Dry weight basis	Reported Averages
Moisture content	11.97%	12.01-14.47%
Protein	28.34%	8.86-18.2%
Ash	4.55%	2.9-4.5%
Fat	1.27%	0.35-8.97%
Crude Fibre	6.18%	4.2-7.9%
Carbohydrate	47.69%	8.36-27.42%
Iron	7.40 mg/100g	3.70-5.14 mg/100g
Zinc	2.74 mg/100g	1.0-1.53 mg/100g
Calcium	129.31 mg/100g	14-102 mg/100g
Total Phenolics (Health benefiting compounds)	15.73 mg/100g	145 mg/100g

Sources of reported averages: Özgür et al. (2019); Kumar and Xu (2017); Soteloet al. (1995); Barros and Prudencio (2016).

Further information

- High in protein content
- High in ash content, implying higher total mineral content
- High in iron, zinc, and calcium
- Low in total phenolics, which could imply increased mineral availability
- Splits after cooking, aromatic, and tasty
- Good for complementary feeding, pregnant, and lactating mothers

Variety Name: Kyobote

Country of origin: Uganda

The seed colour is yellow.

The seed shape is cuboid.

Agronomic Characteristics

- This is a bush variety with erect branches.
- It takes 88 days to mature; considered a medium-maturing variety
- It can yield up to 3700 kg/ha (41 90-kg bags), therefore it is a very high-yielding variety.

Nutritional Value	Dry weight basis	Reported Averages
Moisture content	11.57%	12.01-14.47%
Protein	26.21%	8.86-18.2%
Ash	3.90%	2.9-4.5%
Fat	1.20%	0.35-8.97%
Crude fibre	7.26%	4.2-7.9%
Carbohydrate	49.86%	8.36-27.42%
Iron	6.55 mg/100 g	3.70-5.14 mg/100 g
Zinc	2.75 mg/100 g	1.0-1.53 mg/100 g
Calcium	151.77 mg/100 g	14 – 102 mg/100 g
Total Phenolics (Health benefiting compounds)	13.15 mg/100 g	145 mg/100 g

Sources of reported averages: Özgür et al. (2019); Kumar and Xu (2017); Sotelo et al. (1995); Barros and Prudencio (2016)

Further information

- High in protein content
- High in zinc, iron, and calcium
- Low in total phenolics, which could imply increased mineral availability to the body
- It makes a thick soup and splits after cooking; it is soft and tasty with a nice aroma that is liked by farmers.
- Good for complementary feeding, pregnant, and lactating mothers.

Variety Name: TZA 3100

Country of origin: Tanzania

The seed colour is maroon.

The seed shape is oval.

Agronomic Characteristics

- This is a bush variety with erect branches.
- It takes 77 days to mature and is considered an early-maturing variety.
- It can yield up to 6250 kg/ha (69 90-kg bags); therefore, it is a very high-yielding variety.

Nutritional Value	Dry weight basis	Reported Averages
Moisture content	12.02%	12.01-14.47%
Protein	27.47%	8.86-18.2%
Ash	5.32%	2.9-4.5%
Fat	1.81%	0.35-8.97%
Crude Fibre	6.47%	4.2-7.9%
Carbohydrate	46.91%	8.36-27.42%
Iron	7.61 mg/100g	3.70-5.14 mg/100g
Zinc	2.79 mg/100g	1.0-1.53 mg/100g
Calcium	209.99 mg/100g	14-102 mg/100g
Total Phenolics (Health promoting compounds)	17.70 mg/100g	145 mg/100g

Sources of reported averages: Özgür et al. (2019); Kumar and Xu (2017); Soteloet al. (1995); Barros and Prudencio (2016.

Further information

- High in protein content
- High ash content beans, implying high total mineral content
- High in iron, zinc, and calcium
- Low in total phenolics, which could improve mineral availability to the body.
- Aromatic, soft, and tasty.
- Good for complementary feeding, pregnant, and lactating mothers

Variety Name: TZA 3165

Country of origin: Tanzania

The seed colour is purple white.

The seed shape is kidney type.

Agronomic Characteristics

- This is a bush variety with erect branches.
- It takes 85 days to mature, so it is considered a medium-maturing variety.
- It can yield up to 3750 kg/ha (42 90-kg bags), therefore it is a very high-yielding variety.

Nutritional Value	Dry weight basis	Reported Averages
Moisture content	11.50%	12.01-14.47%
Protein	26.76%	8.86-18.2%
Ash	4.81%	2.9-4.5%
Fat	1.86%	0.35-8.97%
Crude Fibre	6.40%	4.2-7.9%
Carbohydrate	48.66%	8.36-27.42%
Iron	8.34 mg/100 g	3.70-5.14 mg/100 g
Zinc	2.53 mg/100 g	1.0- 1.53 mg/100 g
Calcium	205.01 mg/100 g	14-102 mg/100 g
Total Phenolics (Health benefiting compounds)	6.72 mg/100 g	145 mg/100 g

Sources of reported averages: Özgür et al., 2019; Kumar and Xu, 2017; Sotelo et al., 1995; Barros and Prudencio, 2016.

Further information

- High in protein content
- High in ash content, implying higher total mineral content
- High in iron, zinc, and calcium
- Low total phenolics, which is associated with higher mineral availability to the body
- Soft after cooking
- Good for complementary feeding, pregnant, and lactating mothers

Variety Name: TZA 3990

Country of origin: Tanzania

The seed colour is pale cream.

The seed shape is oval.

Agronomic Characteristics

- This is a bush variety.
- It takes 77 days to mature, so it is considered an early-maturing variety.
- It can yield up to 4800 kg/ha (53x90-kg bags); therefore, it is a very high-yielding variety.

Nutritional Value	Dry weight basis	Reported Averages
Moisture content	12.70%	12.01-14.47%
Protein	26.58%	8.86-18.2%
Ash	6.20%	2.9-4.5%
Fat	1.87%	0.35-8.97%
Crude Fibre	11.29%	4.2-7.9%
Carbohydrate	41.34%	8.36-27.42%
Iron	7.65 mg/100g	3.70-5.14 mg/100g
Zinc	3.17 mg/100g	1.0-1.53 mg/100g
Calcium	181.75 mg/100g	14-102 mg/100g
Total Phenolics (Health promoting benefits)	10.10 mg/100g	145 mg/100g

Sources of reported averages: Özgür et al. (2019); Kumar and Xu (2017); Sotelo et al. (1995); Barros and Prudencio (2016).

Further information

- High in protein content
- High in ash content, implying higher total mineral content
- High in iron, zinc, and calcium
- Zinc content is higher than the limit for common beans.
- Low total phenolics, which is associated with higher availability of minerals
- Makes thick soup and splits after cooking
- Aromatic and tasty
- Good for complementary feeding, pregnant, and lactating mothers

Variety Name: TZA 4174

Country of origin: Tanzania

The seed colour is black.

The seed shape is oval.

Agronomic Characteristics

- This is a bush variety
- It takes 85 days to mature; it is considered a medium-maturing variety.
- It can yield up to 6250 kg/ha (69 90-kg bags); therefore, it is a very high-yielding variety.

Nutritional Value	Dry weight basis	Reported Averages
Moisture content	11.96%	12.01-14.47%
Protein	28.18%	8.86-18.2%
Ash	5.86%	2.9-4.5%
Fat	1.55%	0.35-8.97%
Crude Fibre	7.00%	4.2-7.9%
Carbohydrate	45.45%	8.36-27.42%
Iron	6.88 mg/100g	3.70 -5.14 mg/100g
Zinc	3.19 mg/100g	1.0 – 1.53 mg/100g
Calcium	228.94 mg/100g	14-102 mg/100g
Total Phenolics (Health promoting compounds)	11.74 mg/100g	145 mg/100g

Sources of reported averages: Özgür et al. (2019); Kumar and Xu (2017); Soteloet al. (1995); Barros and Prudencio (2016).

Further information

- High in protein content
- High in ash content, which could imply high total mineral content
- High in iron, zinc, and calcium
- Low in total phenolics, which is associated with increased mineral availability to the body
- Makes thick soup and splits after cooking
- Aromatic and tasty
- Good for complementary feeding, pregnant, and lactating mothers

Variety Name: UNGB 2364

Country of origin: Uganda

The seed colour is pale cream.

The seed shape is oval.

Agronomic Characteristics

- This is a bush variety.
- It takes 82 days to mature, therefore it's an early-maturing variety.
- It can yield up to 3750 kg/ha (42 90-kg bags) therefore it's a very high-yielding variety.

Nutritional Value	Dry weight basis	Reported Averages
Moisture content	12.51%	12.01-14.47%
Protein	26.37%	8.86-18.2%
Ash	4.41%	2.9-4.5%
Fat	1.47%	0.35-8.97%
Crude Fibre	7.05%	4.2-7.9%
Carbohydrate	48.19%	8.36-27.42%
Iron	7.70 mg/100g	3.70-5.14 mg/100g
Zinc	3.08 mg/100g	1.0-1.53 mg/100g
Calcium	228.54 mg/100g	14 -102 mg/100g
Total Phenolics (Health promoting compounds)	7.83 mg/100g	145mg/100g

Sources of reported averages: Özgür et al. (2019); Kumar and Xu (2017); Soteloet al. (1995); Barros and Prudencio (2016).

Further information

- High in protein
- High in ash implying high mineral content
- High in iron and zinc content
- Total phenolics are relatively low, which implies higher nutrient and mineral bioavailability.
- It is soft and tasty, aromatic and splits after cooking, which makes it very desirable for soup dishes.
- Good for complementary feeding, pregnant and lactating mothers

References

Barros, M. and Prudencio, S.H. (2016). Physical and chemical characteristics of common bean varieties Características físicas e químicas de diferentes variedades de feijão comum. doi: 10.5433/1679-0359.2016v37n2p751.

Chávez-Servia, J.L., Heredia-García, E., Mayek-Pérez, N., Aquino-Bolaños, E.N., Hernández-Delgado, S., Carrillo-Rodríguez, J.C., Gill-Langarica, H.R and Vera-Guzmán, A.M (2016). Diversity of Common Bean (Phaseolus vulgaris L.) Landraces and the Nutritional Value of their Grain. Additional information is available at the end of the chapter http://dx.doi.org/10.5772/63439.

Guzmán SH, Acosta JA, Álvarez-Muñoz MA, García-Delgado S, Loarca-Piña G.(2002). Food quality and nutraceutical potential of bean (Phaseolus vulgaris L.). Agricultura Técnica en México. 28:159–173.

Kumar, G. and Xu, B. (2017). Polyphenol-Rich Dry Common Beans (Phaseolus vulgaris L.) and Their Health Benefits¸ International Journal of Molecular Science 18, 2331; doi: 10.3390/ijms18112331 www.mdpi.com/journal/ijms.

Léder, I., (2004), Sorghum and Millets, in Cultivated Plants, Primarily as Food Sources, [Ed. György Füleky], in Encyclopedia of Life Support Systems (EOLSS), Developed under the Auspices of the UNESCO, Eolss Publishers, Oxford, UK. http://www.eolss.net, Accessed on 22/6/2020.

Mubiru, D., Recha, T and Otieno,G, E. (2019) Sensory Evaluation Field Report for Finger Millet and Bean Products , Hoima Uganda. Field Work report from 6th to 12th nd September 2019 Rome, Alliance of Bioversity International and CIAT.

Özgür, Ç., Cüneyt, C., Çağatay, T., Murat, P. , Neslihan, T. (2019). Nutritional and health benefits of legumes and their distinctive genomic properties. Food Science and Technology. ISSN 0101-2061 (Print) ISSN 1678-457X (Online), doi: https://doi.org/10.1590/fst.42117.

Ramashia, S. E., Anyasi, T. A. , Gwata , E.T., Meddows-taylor , S. and Jideani, A. I. O. (2019). Processing, nutritional composition and health benefits of finger millet in sub-saharan Africa. Food Science and Technology. ISSN 0101-2061 (Print) ISSN 1678-457X (Online). doi: https://doi.org/10.1590/fst.25017.

Sotelo, A., Sousa, H. & Sánchez, M.(1995). Comparative study of the chemical composition of wild and cultivated beans (*Phaseolus vulgaris*). *Plant Food Hum Nutr* 47, 93–100. doi: https://doi.org/10.1007/BF01089257.

Bioversity International and the International Center for Tropical Agriculture (CIAT) are part of CGIAR, a global research partnership for a food-secure future.

Bioversity International is the operating name of the International Plant Genetic Resources Institute (IPGRI).

Bioversity International Headquarters - Rome, Italy
Via dei Tre Denari, 472/a
00054 Maccarese (Fiumicino), Italy
Tel. (39-06) 61181
Fax. (39-06) 6118402

www.bioversityinternational.org
www.ciat.cgiar.org
www.cgiar.org