

DLB Product Profile: High yielding, drought tolerant and short duration dry grain pigeonpea for Eastern Africa



Paul Kimani, University of Nairobi

Design target

High yielding, short duration maturity, drought tolerant pigeonpea variety with medium to large cream seeds, suitable for dry grain production and consumption by rural and urban households. In eastern Africa

Paul Kimani is a professor of Genetics and Plant Breeding, and leader of the Legume Breeding Research and Seed Program at the University of Nairobi. The program is based in the Department of Plant Science and Crop Protection, Upper Kabete Campus in Nairobi, Kenya. His main interest is on four legumes important in East, Central and Southern Africa: grain and vegetable common bean (*Phaseolus vulgaris* L), pigeonpea (*Cajanus cajan* L. Millsp), runner bean (*Phaseolus coccineus* L) and soybean (*Glycine max*).

He has more than three decades of experience in legume breeding, agronomy, genetics and seed systems. He is one of the pioneers in market-led breeding in Africa and has successfully developed more than 25 commercial varieties for household consumption and processing industry. He has collaborated with most of the bean research programs in Africa, and shared improved germplasm and breeding lines with researchers in all six continents (Africa, Asia, Australia and the Pacific, Europe, North and South America). He holds a PhD in Plant Breeding & Genetics from the University of Wisconsin-Madison, USA.



Product Profile design team

Step 1

PP Design Team Lead/Champion	Paul Kimani
	Dept of Plant Science and Crop Protection, University of Nairobi, Kenya

PP Design Team		
Person	Area of expertise	Name of organization
Rael Karimi	Breeder	KALRO-Katumani
Paul Kimurto	Agronomist	Egerton University
Arnold Njaimwe	Breeder	KALRO-Katumani
Anthony Gitahi	Pigeonpea specialist/Seed systems	University of Nairobi
Susan Wanderi	Breeder/product development specialist	KALRO- Katumani
Susan Muriithi	Marketing specialist and business development	SUERA LTD, Nyahururu
Veronica K. Moraa	Food scientist	University of Nairobi
Hezekiah Odhiambo	Food scientist	University of Nairobi
Winfred Nyaga	Agricultural economist	University of Nairobi

Clients and markets

Step 2

Product profile descriptors	
Product profile name	High yielding, cream-seeded, short-duration pigeonpea
Crop	Pigeonpea (<i>Cajanus cajan</i> L. Millsp.)
Country	Kenya
Geographic regions	East African Community, Southern Africa and West and Central Africa
Market segment and positioning	Rural and urban consumers, institutions and export to Asian countries; dhal processors
Name of target variety to be replaced	Traditional long duration varieties Strength: Large, cream seeds Weakness: Low yield, very long duration to maturity (up to 12 months), susceptibility to fusarium wilt, <i>Mycovellosiella</i> leafspot, pod fly, pod borers, bruchids and long cooking time
Date PP created	26.2.2022

Target client and use	
Value chain primary clients/customers	Farmers, traders, hotels, rural and urban households, institutions such as schools and colleges, consumers, dhal processors and exporters
Market scale	Local, regional, national and international markets
Use	Food; livestock feed and food supplements
Type of processing	Cooked, flours for food fortification (samosas, cakes, weaning foods, protein extraction for industrial use)
Market class	White/cream

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Target crop producers and production system	
Number of farmers	600,000 -800,0000
% ratio: male to female farmers	40 % male and 60% female
Production system	Open field
Area of production system	160,000 ha
Growth habit	Determinate or non-determinate
Expected level of inputs	Low fertilizer use; limited use crop protection chemicals
Typical yield range of target system	0.3 – 0.5 t/ha
Cropping system	Purestand 30%; 70% intercropped with maize, sorghum, root crops, beans, cowpeas and fruit crops
Mechanization	Mainly manual
Agroecological zone(s)	Low and medium potential semi-arid regions with altitudes 500- 2000masl
Total seed market	2500 tonnes

Variety technical specification

Step 3

Client/customer	Driver	Trait category	Preference group: Women (W) Men (M) Youth (Y) W+M+Y (All)	Trait demand classification: 1. Essential/ "must have" 2. Niche opportunity 3. Added-value 4. Winning trait	Target traits	Trait description (Quantitative measures)	Name of benchmark variety	Performance required compared to benchmark variety <,> etc.
Farmer	Productivity	Yield	All	1	Grain yield	Dry grain weight > 0.8 t/ha	ICPL 87091 or traditional variety	>
		Biotic stress resistance	All	3	Fusarium wilt	Resistant or moderately (on a scale of 1-9, where 1= resistant; 9=susceptible)	Kionza	>
		Abiotic stress	All	1	Drought tolerant	Tolerant or moderately tolerant (score of 4-6 on a scale of 1-9)	Kionza	=
	Crop management and harvesting	Plant architecture	All	1	Short (about 1-1.5m tall), compact or semi-spreading	Determinate or indeterminate growth habit	Kionza	<
		Pods distribution	All	3	Clusters terminally placed on branches	Clusters on the outside of the canopy for ease of harvesting	Kionza	>
	Market value and price	Seed colour	All	1	white	White or cream seed coat	Kionza	=
		Seed size	All	4	Large	>15 g per 100 seeds	Kionza	=
		Crop duration	All	4	Time to maturity	Early (less than 150 days)	ICPL 87091	=
	Post-harvest and storage	Storage-life	All	3	Tolerant to bruchids	Score of 6 or less on a 1-9 susceptibility scale	Kionza	=
	Processor	Raw material quality specification	dhal quality	All	2	Cooking time (firewood or charcoal)	< 40 minutes to cook in household setting	Kionza
Consumer	Satisfaction	Taste	All	1	Taste	Palatability from sensory evaluation with key consumers	Kionza	=

		Appearance	All	1	Seed coat and hilum colour	Cream (without coloured hilum)	Kionza	=
		Digestibility	All	1	Flatulence, soft seed coat after cooking	Low gas production	Kionza	=
		Food preparation	All	2	Cooking time (firewood or charcoal)	whole grain cooks in less than 2 hours in household setting	Kionza	=
Seed producer	Scalability and cost	Seed genetic purity	All	1	Seed germination	> 95% viability >99% uniformity	Kionza	>



(A) Background: Traditional pigeonpea varieties are tall, late maturing, indeterminate and low yielding.

Foreground: Modern variety (NPP 670) shorter in height with clustered pods easier to harvest, early maturing, determinate growth habit, and has large, white/cream seeds (B). Note NPP670 is ready to harvest but the traditional variety is starting to flower. The two types were planted on the same day.

“When we started pigeonpea improvement for Africa, we used an ad hoc way to determine the traits that would be needed in a new variety. We hardly consulted the end users about the kind of variety or traits that were important to them. But this changed when we did a social economic survey of more than 1800 pigeonpea growers in the major production zones. It became evident that end users attached different values to diverse traits. It was not just better yield. We learnt that seed size, seed colour and duration to maturity were key traits. It was difficult to convince our colleagues at ICRISAT (India) that the type of pigeonpea preferred in Africa is different than that preferred in India. It was even harder to convince partners that farmers in Africa did not grow pigeonpea only for food (subsistence). They needed a product they could market and make money.

But there was no way of bringing these diverse aspects of cultivar development into a well thought out, integrated variety design until the concept of product profile was developed. Product profiling helps breeders conceptualize the kind of variety they need to develop, the traits it must have, and clear benchmarks it must meet. It has sharply brought out the business side of plant breeding”.