Highlights
CIAT in Africa

Fast tracking of nutritionally-rich bean varieties

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The Highlights series summarises research results and policy implications from the work of CIAT and its partners in Africa

Micronutrient malnutrition is now recognised as one of the most serious health challenges facing vast sectors of Africa's population particularly resource-poor women and children. Major deficiencies include iron, zinc and vitamins, as well as protein. The main cause of these deficiencies is diets rich in energy but poor in proteins, minerals and vitamins. Moreover, widespread poverty makes it difficult for the majority of people to access the more expensive animal based products, which are rich in vitamins and minerals. Limited knowledge on the nutritional value of locally available foodstuffs has aggravated the situation. The preferred foods, which include cereal-based products, white potatoes and cassava, are generally low in micronutrients.

Dietary improvement is probably the most effective and sustainable strategy for reducing micronutrient deficiencies in Africa

Prevalence of iron deficiency anaemia (IDA) varies from 8% in Ethiopia, to as much as 67% in Tanzania and 69% in Burundi. Zinc deficiency was only recently recognised as a serious public health problem. Zinc is essential for normal growth, appetite, and normal immune function, and is increasingly being recognised as critical in the diets of people suffering from HIV/AIDS.

Strategies for alleviating micronutrient deficiencies

A three-pronged approach has been followed in alleviating the micronutrient deficiency problem in Africa. These are: supplementation of vulnerable groups with micronutrients, fortification of common foods, and dietary improvement. Mineral supplementation is effective for easy to reach vulnerable groups with access to medical facilities. In Eastern and Central Africa, this constitutes a very small group. It requires a large capital input, an elaborate and costly distribution network and patient compliance. This approach leaves out those hard to reach at-risk groups as well as those who are not targeted to receive any kind of supplementation.

Fortification of common foods has had a limited degree of success in Africa because of the under-developed food industry and lack of effective legislation. At present food fortification programmes are operation in only two of the ASARECA member countries in Eastern and Central Africa: Kenya and Uganda. This approach is effective for small affluent communities mostly in urban areas. This again leaves out the majority of urban poor and rural communities.

Dietary improvement is probably the most effective and sustainable strategy for reducing micronutrient deficiencies in Africa. This approach aims to increase dietary availability, regular access and consumption of mineral-rich foods in at-risk and micronutrient-deficient groups. It involves the development of culturally acceptable, mineral rich grains, vegetables and root crops, and promoting their consumption.

Common bean (*Phaseolus vulgaris* L.) offers unique opportunities to address

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	Country of origin	Growth habit	Seed colour	Seed size	Zinc (ppm)	Iron (ppm)	Protein (%)
Micronutrient rich cultivars							
AND 620	DRC	bush	red mottle	large	38	147	20.4
GLP 2	Kenya	bush	red mottle	large	28	124	16.2
G59/1-2	DRC	climber	brown	large	24	106	-
Kiangara	DRC	climber	brown	small	44	104	20.1
LIB 1	DRC	climber	yellow	medium	52	94	20.8
MLB-49-98A	DRC	bush	black	small	55	124	-
Naindeky	DRC	bush	white	small	30	106	21.4
VCB 87013	DRC	climber	white	small	25	122	19.4
VNB 81010	DRC	climber	black	small	62	77	-
Protein rich cultivars	**Country of origin**	**Growth habit**	**Seed colour**	**Seed size**	**Zinc (ppm)**	**Iron (ppm)**	**Protein (%)**
Awash-1	Ethiopia	bush	cream	small	24	-	23.0
Awash Melka	Ethiopia	bush	white	small	28	-	25.3
K 131	Uganda	bush	carioca	small	31	-	25.0
VCB 81012	DRC	climber	brown	medium	32	86	26.4

Table 1: Iron, zinc and protein concentrations in bean cultivars grown in eastern, central and southern Africa

the deteriorating food situation in Eastern and Central Africa. It is the most widely grown and consumed grain legume in the region. Beans are a primary source of protein as well as micronutrients (especially iron and zinc) for over 100 million people in rural and poor urban communities. Beans also provide a significant source of income to rural households.

In 1995, the CGIAR initiated a micronutrient breeding project with the aim of developing the tools needed by plant breeders to produce mineral - and vitamin-dense cultivars of different crops. The target micronutrients were iron and zinc and vitamin A.

Iron and zinc concentrations in African bean germplasm

To determine the variability for iron, zinc and protein concentration, more than 70 varieties and landraces were collected from the Democratic Republic of Congo (DRC), Ethiopia, Kenya, Rwanda, Sudan and Uganda. These genotypes were considered fairly well adapted and acceptable to consumers and therefore could be fast-tracked to production fields and local markets (presumably without serious acceptability problems) if they proved to be rich in micronutrients. Analyses were conducted at the University of Nairobi, CIAT (Colombia), Cornell University (USA) and Copenhagen University (Denmark). Results are shown for a selected number of varieties in Table 1.

Zinc levels

Zinc concentration varied from 12 to 62 parts per million (ppm). Among the top five varieties for zinc were four from DRC (VNB 81010, MLB-49-98A, LIB 1 and Kiangara) and one bred by CIAT (AND 620).

Iron levels

Iron concentrations were higher than that reported for CIAT's sample of its global collection – which had ranged from 55-102 ppm. These differences are mainly attributed to influences of soil type and location. Again, varieties from DRC predominated (MLB-49-98A, VCB 87013, G59/1-2, Naindeky and Kiangara), with one from CIAT (AND 620) and one released by Kenya and Uganda (GLP 2).

Micronutrient rich cultivars

Three varieties representing three seed types consumed in the region, and which combine high levels of both zinc and iron, are as follows: a CIAT bred variety (AND 620); a black-seeded root resistant cultivar developed in DRC and now popular in western Kenya (MLB-49-98A); and a local variety from DR Congo (Kiangara).

Protein rich cultivars

Protein concentration varied from 13 % to 26.4%. Cultivars with high protein levels were a DRC local variety (VCB 81012) and three CIAT-related varieties selected in either Ethiopia (Awash-1 and Awash Melka) or Uganda (K131).

Conclusion

The results indicated that considerable potential exists for improving the micronutrient and protein nutrition by promoting consumption of bean cultivars rich in these nutrients. Other popular bean cultivars low in these nutrients can be improved through breeding. The first regional nursery for nutrient-rich beans, with 38 materials, was constituted in 2004. This set has been distributed to collaborating programmes in Burundi, DRC, Ethiopia, Kenya, Malawi, Rwanda and Uganda for agronomic evaluation.

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