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Biofortification research on dryland cereals and grain legumes at ICRISAT

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Abstract

Deficiency of iron (Fe), zinc (Zn) and Vitamin-A is widespread in India and Sub-Saharan Africa (SSA). Primary cause of such deficiency is poor dietary quality. Therefore, increasing target micronutrient content in staple crops is essential for human health. Grain legumes (chickpea, pigeonpea, groundnut) and dryland cereals (sorghum, pearl millet and finger millet) are staple foods in the arid and semi-arid tropical regions of India and SSA. Considering growing population in these regions, demand for these crops is strongly projected to increase 2-fold. To address food and nutritional security simultaneously, biofortification is a sustainable breeding strategy to deliver micronutrient in organic form and in the food products typically consumed by large and remote populations. International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) examined variability for iron and zinc in mandate crops, and calcium in finger millet and oleic acid in groundnut. Commercially grown cultivars of grain legumes and dryland cereals screened for these target nutrients. Pearl millet commercial hybrids (122) have an average of 42 ppm Fe and 32 ppm Zn whereas, sorghum has 30 ppm Fe and 20 ppm Zn. Similarly, chickpea varieties contain 40-55 ppm of Fe and 25-35 ppm and pigeon pea varieties contain 25-40 ppm Fe and 25-35 ppm Zn. Defining micronutrient bench marks for many crops is underway. Much larger variability (2-3 fold) reported for Fe and Zn contents in the breeding lines and germplasm of these crops. Development and standardization of rapid and cost-effective screening techniques (XRF, NIRS) have played a significant role in accelerating the breeding process for developing cultivars with higher levels of these micronutrients. So far, 7 biofortified pearl millet cultivars (Dhanashakti, AHB 1200Fe, HHB 299, HHB 311, RHB 233 and DHBH 1211), and one sorghum variety (Parbhani shakti) released in India. Recently, high-Fe/Zn groundnut variety, ICGV 06099 (57 ppm Fe and 81 ppm Zn) and ICGV 06040 (56 ppm Fe and 80 ppm Zn), and several lines with >80% oleic acid content were identified. ICRISAT's mainstreaming micronutrients in high-yielding varieties, eventually implemented at NARS partners for all future varieties to be biofortified. Biofortified varieties will not have any compromise on farmers-preferred traits as agronomically equivalent or superior to the less nutrient-dense market varieties. Several biofortified source and advanced lines are available with ICRISAT and utilization of these in partners' breeding programs will eventually lead to greater impact on human nutrition. Apparently, these crops are cultivated in rainfed conditions, so better use of recommended dose of fertilizer are desirable to complement soil fertility and nutrient consistency in biofortified grains.