Options for enhancing grain iron and zinc concentrations in sorghum

Sorghum is the fifth largest cereal crop grown in the world and is a staple food, particularly in the semi-arid tropics. The per capita annual sorghum consumption in sorghum eating populations is more than 75 Kg and it contributes to more than 50% of the dietary micronutrient requirements, particularly the low-income group populations. We at ICRISAT assessed a range of sorghum cultivars grown in India for the grain Fe/Zn concentrations and found that the average grain Fe [30 parts per million (ppm)] and Zn (20 ppm) concentrations of these cultivars is low. Therefore, we have set a target of 60 ppm Fe and 40 ppm Zn for sorghum, which means doubling the grain Fe and Zn concentrations in sorghum from the base level of 30 ppm Fe and 20 ppm Zn to combat the micronutrient deficiencies in sorghum eating populations.

Our work on sorghum biofortification under HarvestPlus indicated that in the commercial sorghum hybrids grown in India, the grain Fe content was close to 40 ppm with Zn content close to 30 ppm in the best genotype. We attempted Fertifortification too but the exogenous micronutrient fertilization did not increase the grain Fe and Zn concentrations appreciably, particularly when the nutrients are not limiting in soil. Therefore we pursued sorghum genetic enhancement for grain Fe/Zn concentrations. Under this program more than 2200 core germplasm accessions were screened and accessions with >60 ppm Fe and >40 ppm Zn concentrations identified and used in the crossing programs to develop transgressive segregants with desired Fe/Zn concentrations and agronomic traits. Two prominent accessions with high Fe/Zn concentrations [IS 23680 (Fe 71 ppm and Zn 44 ppm) from Mozambique and IS 26962 (Fe 52 ppm and Zn 47 ppm) from India] and agronomic desirability were identified. While both these lines surpassed the target of 40 ppm Zn, one line showed higher Fe content than the target 60 ppm (IS 23680). Inheritance studies indicated that while grain Zn is conditioned by additive gene action both additive and non-additive gene action plays a role in conditioning grain Fe. Both Fe and Zn concentrations are positively correlated (r=0.6-0.8) indicating that simultaneous improvement of these two minerals is possible. We standardized a robust cost-effective method (XRF) for assessing the grain Fe and Zn concentration.

In addition, some promising R-lines/varieties (>5) with agronomic eliteness and high grain Fe/ Zn concentrations identified. We also identified some promising hybrid parents (>20) and hybrids (6) with high Fe/Zn concentrations that can be commercialized after appropriate testing. Further, we developed >350 new hybrids from selected parents and evaluated them for yield and Fe/Zn concentrations and identified promising hybrids for multilocation testing.

Biography

A Ashok Kumar has completed his Ph.D at the age of 28 years from Indian Agricultural Research Institute, New Delhi and joined as a scientist in Acharya NG Ranga Agricultural University, Hyderabad. Currently he is a senior scientist at ICRISAT, a non-profit, non-governmental International Research and Development Organization based in India. He has published more than 40 papers in reputed journals and developed 2 varieties and >20 hybrid parents which are widely used by industry and farmers. He authored 12 book chapters, edited 3 books and guided 3 students.

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