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Biofortified Varieties of Field Crops in India

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Malnutrition has emerged as a major health problem. It affects growth and development, and reduces the work efficiency in humans, besides having huge economic and societal implications. Though various strategies viz., 'food-fortification', 'medical-supplementation' and 'dietary diversification' are used to alleviate malnutrition, they do not offer sustainable solution as these avenues are often limited by lack of purchasing power, robust distribution systems and crop seasonality. On the contrary, 'crop biofortification' has emerged as the preferred choice as it is sustainable and cost-effective, and nutrients reach the target people in natural form (1, 2). ICAR and State Agricultural Universities (SAUs) have made significant progress in development of high yielding biofortified varieties and hybrids in cereals, millets, pulses, oilseeds, vegetables and fruits. Dedication of biofortified crop cultivars on October 16, 2020 (World Food Day) and September 28, 2021, respectively by the Hon'ble Prime Minister to the nation is a testimony to the commitment of the country and of the Indian Council of Agricultural Research (ICAR) towards fulfilling country's food and nutrition security. ICAR has developed 87 biofortified cultivars in 16 crops that can be integrated into the food chain to enable better health of human and animal populations. Of these, 48 cultivars are multi nutrient-dense in nature with two or more traits combined in a single genotype. This article gives the details about some biofortified varieties developed in India in recent past.

Rice : CR Dhan 310 (Pure line variety)- Year of release: 2016

Contains 10.3% protein in polished grain as compared to 7.0-8.0% in popular varieties

Grain yield: 45.0 q/ha

Maturity: 125 days

Adaptation: Odisha, Madhya Pradesh and Uttar Pradesh

Developed by ICAR-National Rice Research Institute, Cuttack, Odisha

Rice : DRR Dhan 45 (Pure line variety) - Year of release : 2016

High in zinc content (22.6 ppm) in polished grains in comparison to 12.0-16.0 ppm in popular varieties

Grain yield: 50.0 q/ha

Maturity: 125-130 days

Adaptation: Karnataka, Tamil Nadu, Andhra Pradesh and Telangana

Developed by ICAR-Indian Institute of Rice Research, Hyderabad

Wheat : WB 02 (Pure line variety) - Year of release: 2017

Rich in zinc (42.0 ppm) and iron (40.0 ppm) in comparison to 32.0 ppm zinc and 28.0-32.0 ppm iron in popular varieties

Grain yield: 51.6 q/ha

Maturity: 142 days

Suitable for irrigated timely sown conditions

Adaptation: Punjab, Haryana, Delhi, Rajasthan (excluding Kota and Udaipur division), Western UP (except Jhansi division), Jammu and Kathua district of J & K, Paonta Valley and Una district of HP and Tarai region of Uttarakhand

Developed by ICAR-Indian Institute of Wheat and Barley Research, Karnal

Wheat : HPBW 01 (Pure line variety) - Year of release: 2017

Contains high iron (40.0 ppm) and zinc (40.6 ppm) in comparison to 28.0-32.0 ppm iron and 32.0 ppm zinc in popular varieties

Grain yield: 51.7 q/ha

Maturity: 141 days

Suitable for irrigated timely sown conditions

Adaptation: Punjab, Haryana, Delhi, Rajasthan (excluding Kota and Udaipur division), Western UP (except Jhansi division), Jammu and Kathua district of J & K, Paonta Valley and Una district of HP and Tarai region of Uttarakhand

Developed by PunjabAgricultural University, Ludhiana under ICAR-All India Coordinated Research Project on Wheat & Barley

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Maize : Pusa Vivek QPM9 Improved (Hybrid) - Year of release : 2017

Country's first provitamin-A rich maize.

High provitamin-A (8.15 ppm), lysine (2.67%) and tryptophan (0.74%) as compared to 1.0-2.0 ppm provitamin-A, 1.5-2.0% lysine and 0.3-0.4% tryptophan content in popular hybrids.

Grain yield: 55.9 q/ha [Northern Hills Zone (NHZ)] and 59.2 q/ ha [Peninsular Zone (PZ)].

Maturity: 93 days (NHZ) and 83 days (PZ).

Adaptation:KharifseasoninJ&K,HimachalPradesh,Uttarakhand (Hill region), North Eastern states, Maharashtra, Karnataka, AP, Telangana and Tamil Nadu.

Developed by ICAR-Indian Agricultural Research Institute, New Delhi.

Maize : Pusa HM4 Improved (Hybrid) - Year of release: 2017

Contains 0.91% tryptophan and 3.62% lysine which is significantly higher than popular hybrids (0.3-0.4% tryptophan and 1.5-2.0% lysine).

Grain yield: 64.2 q/ha.

Maturity: 87 days.

Adaptation: Kharif season in Punjab, Haryana, Delhi, Uttarakhand (Plain), Uttar Pradesh (Western region)].

Developed by ICAR-Indian Agricultural Research Institute, New Delhi.

Maize : Pusa HM8 Improved (Hybrid) - Year of release: 2017

Rich in tryptophan (1.06%) and lysine (4.18%) as compared to 0.3-0.4% tryptophan and 1.5-2.0% lysine in popular hybrids.

Grain yield : 62.6 q/ha.

Maturity : 95 days.

Adaptation : Kharif season in Maharashtra, Karnataka, Andhra Pradesh, Telangana, Tamil Nadu

Developed by ICAR-Indian Agricultural Research Institute, New Delhi.

Maize : Pusa HM9 Improved (Hybrid) - Year of release: 2017

Contains 0.68% tryptophan and 2.97% lysine compared to 0.3-0.4% tryptophan and 1.5-2.0% lysine in popular hybrids.

Grain yield: 52.0 q/ha.

Maturity: 89 days.

Adaptation: Kharif season in Bihar, Jharkhand, Odisha, Uttar Pradesh (Eastern region) and West Bengal.

Developed by ICAR-Indian Agricultural Research Institute, New Delhi.

Pearl millet : HHB 299 (Hybrid)- Year of release: 2017

High iron (73.0 ppm) and zinc (41.0 ppm) as compared to 45.0-50.0 ppm iron and 30.0-35.0 ppm zinc in popular varieties/hybrids.

Grain yield: 32.7 q/ha.

Dry fodder yield: 73.0 q/ha.

Maturity: 81 days.

Adaptation: Kharif season in Haryana, Rajasthan, Gujarat, Punjab, Delhi, Maharashtra and Tamil Nadu

Developed by CCS-Haryana Agricultural University, Hisar in collaboration with ICRISAT, Patancheru under ICAR-All India Coordinated Research Project on Pearl millet.

Pearl millet : AHB 1200 (Hybrid) - Year of release: 2017

Rich in iron (73.0 ppm) in comparison to 45.0-50.0 ppm in popular varieties/hybrids.

Grain yield: 32.0 q/ha.

Dry fodder yield: 70.0 q/ha.

Maturity: 78 days.

Adaptation: Kharif season in Haryana, Rajasthan, Gujarat, Punjab, Delhi, Maharashtra and Tamil Nadu

Developed by Vasantrao Naik MarathwadaKrishi Vidyapeeth, Parbhani (MS) in collaboration with ICRISAT, Patancheru under ICAR-All India Coordinated Research Project on Pearl millet.

Lentil : Pusa Ageti Masoor (Pure line variety) - Year of release : 2017

Contains 65.0 ppm iron as compared to 55.0 ppm iron in popular varieties.

Grain yield: 13.0 q/ha.

Maturity: 100 days.

Medium seed with orange cotyledon.

Suitable for rainfed condition.

Adaptation: Utter Pradesh, Madhya Pradesh, Chhatisgarh.

Developed by ICAR-Indian Agricultural Research Institute, New Delhi.

Mustard : Pusa Mustard 30 (Pure line variety)- Year of release : 2013

Contains lower ucic acid (<2.0%)in oil as compared to >40% erucic acid in popular varieties.

Oil content: 37.7%.

Seed yield: 18.2 q/ha.

Maturity: 137 days.

Suitable for timely sown irrigated conditions.

Adaptation: Utter Pradesh, Uttrakhand, Madhya Pradesh and Rajasthan.

Developed by ICAR-Indian Agricultural Research Institute, New Delhi.

Mustard : Pusa Double Zero Mustard 31 (Pure line variety) - Year of release: 2016

Country's first Canola Quality Indian mustard variety.

Low erucic acid (<2.0%) in oil and glucosinolates (<30.0 ppm) in seed meal as compared to >40.0% erucic acid and >120.0 ppm glucosinolates in popular varieties.

Oil content: 41.0%.

Seed yield: 23.0 q/ha.

Maturity: 142 days.

Suitable for timely sown irrigated conditions.

Adaptation : Rajasthan (North and Western parts), Punjab, Haryana, Delhi, Western UP, Plains of J&K and HP.

Developed by ICAR-Indian Agricultural Research Institute, New Delhi.

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