

High yielding varieties

for enhancing the production of small millets in India

K Hariprasanna*

ICAR-Indian Institute of Millets Research, Rajendranagar, Hyderabad, Telangana 500 030

Small millets are a group of small-grained cereal crops, have a unique place in Indian agriculture though they contribute less than 1% to the annual cereal grain production. Traditionally these crops have been the indispensable component of dry farming system and areas where other crops can not be cultivated profitably. These crops are important in tribal and hill agriculture.

Keywords: Breeding, Early duration, Grain yield, Productivity, Tolerance

AMONG small millets (finger millet, little millet, kodo millet, foxtail millet, barnyard millet, proso millet and browntop millet), finger millet is the most important crop grown widely in India from sea level to 8000 feet altitude in Himalayas. The major states growing finger millet are Karnataka, Uttarakhand, Tamil Nadu, Maharashtra, Odisha and Andhra Pradesh. The kodo, little and foxtail millets are grown widely in Karnataka, Tamil Nadu, Telangana, Andhra Pradesh, Odisha, Bihar, Madhya Pradesh and Maharashtra. In Madhya Pradesh, both kodo and little millet are predominant, while foxtail millet is important in Andhra Pradesh and Karnataka. Barnyard millet and proso millet are grown largely in hills of Uttarakhand, Uttar Pradesh, North-Eastern region and plains of North Bihar and Western Uttar Pradesh and Maharashtra. Nearly 68% of area under small millets is occupied by finger millet, followed by little and kodo millets (about 10%) and rest by barnyard, foxtail and proso millets.

Crop improvement

The crop improvement efforts in small millets are not comparable to other cereals. As these crops are mostly confined to marginal lands, less attention was given in spite of their nutritional superiority. With the launch of a separate All India Coordinated Research Project on Small Millets (AICRP-SM) in 1986 the focus on small millets was enhanced. AICRP-SM acts as the nodal agency to plan, coordinate and execute the research programmes to augment the production and productivity of small millets at all India level.

After the launch of AICRP-SM a number of improved varieties possessing higher yield, variable maturity, tolerance to various diseases and insect pests have been evolved and released for general cultivation across the country (Table 1). With the concerted efforts significant genetic enhancement has been achieved in case of finger millet and satisfactory yield enhancement in foxtail and barnyard millets. The improved varieties released in small millets during the last 10–15 years along with their salient features are given in Table 1–7.

Table 1. Improved varieties released in small millets

Crop	No of varieties released		Total
	Before 1986	From 1986 to 2022	
Finger millet (1918–2022)	45	97	142
Foxtail millet (1942–2022)	12	26	38
Little millet (1954–2022)	6	26	32
Proso millet (1954–2022)	8	19	27
Barnyard millet (1949–2022)	4	18	22
Kodo millet (1942–2022)	11	30	41
Total	86	216	302

Table 2. Improved finger millet varieties released in India in the last 10 years

Variety	Year of release	Maturity (days)	Av. yield (q/ha)	Area of adaptation	Special features
Phule Kasari (KOPN 942)	2022	100-110	22-23	Maharashtra	Highly resistant to finger blast and neck blast
Gossaigaon Marua Dhan	2022	125-130	30-31	Assam	Moderately resistant to leaf blast and neck blast, resistance to lodging and shattering
Birsa Marua 3	2021	110-112	26-27	Jharkhand	Moderately resistant to neck and finger blast, resistant to brown spot, banded sheath blight and foot rot
Dapoli 3 (DPLN-2)	2021	125	20-22	Konkan region of Maharashtra	Moderately resistant to neck blast and finger blast; protein – 7.52%
ATL-1 (TNEc 1285)	2021	105-110	30-31	Tamil Nadu	Drought tolerant, moderately resistant to leaf, neck and finger blast; non-lodging, rich in protein (11.9%) and calcium (325 mg/100 g)
Chhattisgarh Ragi 3 (BR-14-3)	2021	110-115	32-33	Assam, Bihar, Chhattisgarh, Jharkhand, Uttarakhand, Madhya Pradesh	Non-lodging, non-shattering, tolerant to leaf, finger and neck blast, moderately resistant to grass hopper, Myllocerous weevil and shoot aphid
CFMV 3 (Ekvijay) (FMV-1137)	2021	120-125	32-33	Andhra Pradesh, Tamil Nadu, Telangana, Maharashtra, Gujarat	Moderately resistant to leaf blast, finger blast, neck blast, foot rot and banded blight; calcium - 470 mg/100 g, Iron - 38 mg/kg, Zinc - 24.6 mg/kg
Gowthami (PR 10-45)	2020	122-125	35-37	Andhra Pradesh	Moderately resistant to leaf blight, banded blight and leaf and neck blast, high Zinc (26.5 ppm) and calcium (341 mg/100 g)
VL-382	2020	106-108	11-13	Rainfed organic conditions of Uttarakhand hills	Suitable for processing industry
VL-378	2020	110-114	22-24	Rainfed organic conditions of Uttarakhand hills	High in calcium (361.3 mg/100 g)
CFMV-2	2020	119-121	29-31	Andhra Pradesh, Chhattisgarh, Gujarat, Maharashtra, Odisha	Resistant to leaf blast, foot rot, brown spot, grain mould and moderately resistant to neck blast, finger blast and banded blight
CFMV-1 (Indravathi)	2020	110-115	30-32	Andhra Pradesh, Karnataka, Tamil Nadu, Puducherry, Odisha	Resistant to Finger blast, Neck blast, Banded blight and Foot rot, Shoot aphids, stem borer and grass hoppers; rich in calcium (428.3 mg/100 g), iron (58.3 mg/kg), zinc (44.5 mg/kg)
VR-988	2020	110-115	28-30	Andhra Pradesh	Moderately resistant to blast, banded sheath blight; defoliators, ear head caterpillar and aphids
KMR-630	2020	95-100	28-30	Karnataka	Tolerant to neck blast and finger blast, Stem borer, Aphids, grass hopper and ear head caterpillar. Suitable for mechanical harvesting.
GN 8	2019	105-110	31-32	Gujarat	Erect and non-lodging, moderately resistant to blast, foot rot, tolerant to stem borer and aphids
Tirumala (PPR 1012)	2019	115-120	35-37	Andhra Pradesh	Tolerant to leaf blast, neck blast and finger blast, moderately resistant to leaf blight and banded blight
Vegavathi (VR 929)	2019	115-120	36-37	All states	Highly resistant to brown spot, banded blight, foot rot and <i>Cercospora</i> leaf spot; resistant to leaf, finger and neck blast
VL Mandua-380	2019	115-116	18-19	Uttarakhand	High yielding and blast tolerant, light copper colour grains
DHFM 78-3	2018	114-116	28-32	Agro-climatic Zone-3 & 8 of Karnataka	Resistant to finger and neck blast, suitable for contingency planting
Chhattisgarh Ragi-2 (BR-36)	2018	115-118	34-36	Chhattisgarh	Moderately resistant to neck and finger blast, tolerant to stem borer
VL-379	2017	105-107	30-32	Uttarakhand, Bihar, Jharkhand, Madhya Pradesh and North eastern states	Resistant to neck and finger blast, moderately resistant to banded sheath blight
GNN-7	2017	123-128	24-25	Gujarat	High crude fibre, Calcium, Phosphorous and good amount of protein, fat, carbohydrates and magnesium
Co 15	2017	115-125	29-34	Tamil Nadu	Non-lodging, resistant to leaf, neck and finger blasts, bold and copper red colour seeds
Dapoli-2 (SCN-6)	2017	118-120	25-27	Konkan region of Maharashtra	Rich in iron and calcium, moderately resistant to blast, tolerant to aphids and <i>Spodoptera</i>
KMR 340	2016	90-95	35-40	Karnataka	White ragi variety, especially for confectionary purpose, resistant to blast and blight diseases, tolerant to stem borer and aphids

Variety	Year of release	Maturity (days)	Av. yield (q/ha)	Area of adaptation	Special features
VL Mandua-348	2016	104-112	18-20	Uttarakhand	Suitable for organic cultivation, resistant to neck and finger blast, tolerant to lodging, light copper colour seed
GNN-6	2016	120-130	28-30	Gujarat	Moderately resistant to leaf blast and finger blast
GN-5	2016	120-130	25-27	Gujarat	Late maturing, white colour seed, moderately resistant to leaf and finger blast
VL 376	2016	103-109	29-31	All states	Responsive to fertilizer and moderately resistant to blast
VL 352	2012	95-100	33-35	Uttarakhand	Moderately resistant to blast, early duration
Indira Ragi-1	2012	120-125	25-26	Chhattisgarh	Moderately resistant to neck and finger blast and tolerant to stem borer
PPR 2700 (Vakula)	2012	105-110	25-30	Andhra Pradesh	Resistant to leaf blast and tolerant to drought
VR 936 (Hima)	2012	115-120	28-30	Andhra Pradesh	Suitable for late conditions
KMR 204	2012	100-105	30-35	Karnataka	Early duration
OEB 532	2012	110-115	22-25	Odisha, Chhattisgarh, Karnataka, Maharashtra and Tamil Nadu	Moderately resistant to blast, highly tolerant to myllocerus weevil, earhead caterpillars, stem borer and grass hopper

Table 3. Improved little millet varieties released in India in the last 10 years

Variety	Year of release	Maturity (days)	Av. yield (q/ha)	Area of adaptation	Special features
Kalinga Suan 217 (OLM 217)	2021	105-110	15-16	Odisha	Resistant to rust and grain smut, moderately resistant to sheath blight, tolerant to shootfly
Chhattisgarh Sonkutki (BL-41-3)	2021	95-100	16-19	Chhattisgarh	Early maturing, suitable for millet-niger, millet-horsegram and millet-urdbean cropping system, tolerant to rust and sheath blight
CLMV 1 (Jaicar Sama 1)	2020	98-102	15-17	Maharashtra, Andhra Pradesh, Telangana, Tamil Nadu, Puducherry	Tolerant to shoot fly, banded blight, leaf blight and brown spot diseases, high grain iron (58.8 ppm), zinc (35 ppm) and protein (12.8%)
ATL-1 (TNPsc 177)	2019	85-90	-	Tamil Nadu	Early maturity, bold grains with high bulk density, tolerant to drought, shoot fly, grain smut and sheath blight
GNV-3	2018	110-115	28-29	Gujarat Zone-I, II & III	Bold seeded, multi-tillering, non-lodging, resistant to grain smut and sheath blight, high in minerals and crude fibre
DHLM-14-1	2018	97-99	16-17	Tamil Nadu, Karnataka, Gujarat, Maharashtra and Odisha	Tolerant to shoot fly
DHLM 36-3	2018	95-100	14-16	Karnataka	Late maturing
BL 6	2016	90-95	12-14	All states	Suitable for upland cultivation, rich in zinc and calcium
Chhattisgarh Kutki-2 (BL 4)	2016	90-95	10-12	Chhattisgarh	High iron content, tolerant to major pests
GV-2	2016	115-125	26-28	Gujarat	White and bold seeds, resistant to pest and diseases
Phule Ekadashi (KOPLM 83)	2016	120-130	12-14	Sub-mountainous and Ghat zone of Maharashtra	Non-lodging
Jawahar Kutki 4 (JK 4)	2016	75-80	13-15	Rainfed areas of Madhya Pradesh	Resistant to drought, lodging, Shoot fly, moderately resistant to head smut

Table 4. Improved kodo millet varieties released in India in the last 10 years

Variety	Year of release	Maturity (days)	Av. yield (q/ha)	Area of adaptation	Special features
ATL1 (TNPsc 176)	2021	105-110	25-26	Tamil Nadu	Tolerant to shoot fly, Grain smut and sheath blight, Non lodging and uniform maturity
Gujarat Kodo millet 4 (Dahod Kodra-4)	2021	106-113	2738	Gujarat	Moderate resistance to head smut; protein - 8.74%
Dahod Kodo (CKMV 2)	2021	107-110	28-29	Andhra Pradesh, Chhattisgarh, Gujarat, Madhya Pradesh and Tamil Nadu	Moderately resistant to Head smut, banded blight, leaf blight and brown spot, shootfly

Variety	Year of release	Maturity (days)	Av. yield (q/ha)	Area of adaptation	Special features
CKMV 1 (ATL-2)	2021	106-110	28-29	All States	Tolerant to Brown spot, Leaf blight and Head smut diseases, shootfly
Chhattisgarh Kodo-03 (BK-36)	2021	105-110	26-27	All India	Lower incidence of diseases
Gujarat Anand Koda-3 (GAK-3)	2020	105-110	24-25	Gujarat	Highly resistant to shoot fly and moderately resistant to Head smut disease
Jawahar Kodo-137	2016	100-105	26-29	Rainfed areas of Madhya Pradesh	Suitable for sole as well as inter/mixed cropping, responsive to NPK, resistant to drought, lodging, and key pest Shoot fly and moderately resistant to head smut
Chattisgarh Kodo-2	2014	95-100	25-26	Chhattisgarh	Early maturing, resistant to major insect pests
Indira Kodo-1 (BK-1)	2012	100-105	22-25	Chhattisgarh	Highly responsive to fertilizers, suitable for late sown condition
TNAU 86	2012	95-110	27-30	All states	Resistant to head smut, sheath blight, brown spot and tolerant to drought
RK 390-25	2012	100-105	25-28	All states	Moderately resistant to head smut, non-shattering and non-lodging

Table 5. Improved foxtail millet varieties released in India in the last 15 years

Variety	Year of release	Maturity (days)	Av. yield (q/ha)	Area of adaptation	Special features
Renadu (SiA3223)	2020	86-90	30-35	Andhra Pradesh	High yielding, medium bold grains, tolerant to blast and downy mildew
Garuda (SiA 3222)	2020	60-62	15-18	Andhra Pradesh	Extra early variety
ATL-1 (TNSi 331)	2020	80-85	21-22	Tamil Nadu	Non-shattering, non-lodging, drought tolerant
Hagari Navane-46	2019	85-90	16-18	Zone -1, 2 and 3 of Karnataka	Bigger seed size and medium duration
DHFt 109-3	2018	86-88	28-29	Agro-climatic Zone-3 & 8 of Karnataka	Suitable for contingency planting
Suryanandi (SiA 3088)	2018	70-75	20-25	Andhra Pradesh	High seed yield, resistant to blast and downy mildew
RAU-2 (Rajendra Kauni 1)	2017	80-83	23-25	Irrigated and Rainfed upland of Bihar	Resistant to leaf blast, rust, smut, brown spot, downy mildew and leaf blight, high iron and zinc content
SiA 3156	2014	85-90	20-25	All states	High seed yield, tolerant to shootfly
SiA 3085	2011	75-82	20-30	All states	High yielding, resistant to blast and downy mildew
HMT 100-1	2008	90-95	20-25	Karnataka	High tillering, stay green character

Table 6. Improved barnyard millet varieties released in India in the last 15 years

Variety	Year of release	Maturity (days)	Av. Yield (q/ha)	Area of adaptation	Special features
Phule Barti-1 (KOPBM 46)	2022	95-105	17-18	Maharashtra	Non-lodging, shiny grey seed colour
DHBM -23-3 (DHB-23-3)	2019	88-100	23-26	Andhra Pradesh, Karnataka, Madhya Pradesh and Tamil Nadu	High grain and fodder yield
DHBM 93-3	2018	90-95	22-24	Andra Pradesh, Bihar, Karnataka, Madhya Pradesh and Tamil Nadu	Resistance to shootfly
MDU-1	2018	95-100	15-17	Southern Tamil Nadu	All seasons, no-shattering, high milling recovery
DHBM 93-2	2018	86-88	27-28	Agro-climatic Zone-3 & 8 of Karnataka	Suitable for contingency planting
Co 2 (TNAU 43)	2009	95-100	21-22	Tamil Nadu	Non lodging, profuse tillering, best for contingency planting
VL Madira 207	2008	80-90	16-18	Uttarakhand	Non lodging, non shattering
ER 64 (Pratap Sawan 1)	2008	85-90	15-17	Rajasthan	Resistant to smut and tolerant to shootfly, dual purpose variety, very early duration

Table 7. Improved proso millet varieties released in India in the last 15 years

Variety	Year of release	Maturity (days)	Av. yield (kg/ha)	Area of adaptation	Special features
ATL1 (TNPm230)	2018	72-74	21-23	Tamil Nadu, Karnataka and Bihar	Early maturing, drought tolerant
PMV 442 (GPUP 25)	2019	70-75	14-16	All states	Moderately resistant to brown spot and shoot fly
DHPM-2769	2018	70-72	24-25	Agro-climatic Zone-3 & 8 of Karnataka	Suitable for contingency planting
TNAU 202	2011	70-75	18-20	Drylands of India	Resistant to brown spot, sheath blight and rust
TNAU 164	2009	70-75	18-20	All states	Resistant to rust, non-lodging, non-shattering
TNAU 151	2008	70-75	18-20	Tamil Nadu	Resistant to rust tolerant to shootfly and drought
PRC 1	2008	70-75	10-12	Uttarakhand hills	Resistant to <i>Helminthosporium</i> leaf blight
TNAU 145	2007	70-75	18-20	All states	Resistant to rust, shootfly and tolerant to drought
Co 5 (TNAU 143)	2007	70-75	20-23	Tamil Nadu	Resistant to brown spot, rust, grain smut, tolerant to shootfly and drought

SUMMARY

Growing improved varieties in place of local varieties alone can result in incremental yield benefit of around 25–30%. Choosing appropriate variety depending on location and time of sowing is very important apart from good crop management. Availability of seeds of high yielding varieties is a limitation. By the efforts of ICAR-Indian Institute of Millets Research, 18 Seed hubs have been established at different parts of country with the funding from Department of Agriculture &

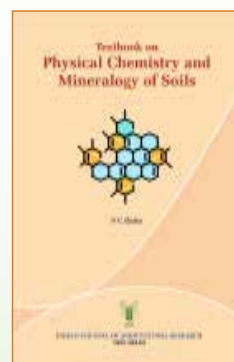
Farmers Welfare (DAF&W). The objective of these Seed hubs along with enhanced Breeder seed production programme by the DAF&W is to supply the latest high yielding variety seeds at reasonable price for enhancing the production of small millets from rainfed agriculture in India.

*Corresponding author's e-mail: hari@millets.res.in

Textbook on Physical Chemistry and Mineralogy of Soils

Physical chemistry of soil and soil mineralogy are the two pillars which form the basic foundation of soil science. Once the students become familiar with these basic concepts, they can easily understand the other properties of the soil, say physical and biological properties, pedology and soil fertility. To become an expert of soil fertility, comprehensive knowledge of all the soil properties is essential which in turn is supported by the knowledge of physical chemistry of soils and soil mineralogy.

The present Textbook on 'Physical Chemistry and Mineralogy of Soils' has been written very cogently by the author who has been a teacher with an experience of nearly four decades of teaching in a premier Institute that is ICAR-Indian Agricultural Research Institute. The book includes all the topics prescribed by ICAR for the Postgraduate students of Soil Science. The introductory chapter describes basic definitions of soil science. Chapters like 'Bonding in solid structures', 'Elements of crystallography', 'Chemical thermodynamics' and 'Electrochemistry of soils and clays' are basic in nature and have been dealt very lucidly for easy understanding of students. Two chapters on characterisation of soil minerals are practical oriented. Other chapters focus on the structures of soil minerals, weathering and formation of minerals in soil environment, adsorption and ion exchange on soil colloids, double layer theory of soil colloids—its evolution and application, chemisorption and precipitation reactions in soil, soil organic colloids and their properties and chemistry of submerged soil. This book will be very much useful for the Postgraduate students of Soil Science.



TECHNICAL SPECIFICATIONS

No. of pages : i-xii + 348 • Price : ₹ 650 • ISBN No. : 978-81-7164-228-1

For obtaining copies, please contact:

Business Unit

Directorate of Knowledge Management in Agriculture
Krishi Anusandhan Bhavan-I, Pusa, New Delhi 110 012
Tel : 011-25843657, Fax 91-11-25841282; e-mail : bmicar@gmail.com