



Sixth Annual Zonal Workshop of KVK'S (Maharashtra, Gujrat & Goa)



28 – 30 July, 2023

Millets Production Technology



Presented by :

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- Government of India had proposed to United Nations for declaring 2023 as International Year of Millets (IYOM). The proposal of India was supported by 72 countries and United Nation's General Assembly (UNGA) declared 2023 as International Year of Millets on 5th March, 2021.
- Now, Government of India has decided to celebrate IYOM, 2023 to make it peoples' movement so that the Indian millets, recipes, value added products are accepted globally.

“International Year of Millets”: Objectives



1. Enhancement of production/ productivity
2. Nutrition & health benefits
3. Value-addition, Processing & Recipe Development
4. Entrepreneurship / Startup / Collective Development
5. Awareness creation – Branding, Labelling & Promotion
6. International outreach of millets
7. Policy interventions for mainstreaming of millets

Definition of MILLETS - THE NUTRICEREALS

Millets are collective group of small seeded annual grasses that are grown as grain crops, primarily on marginal land in dry areas of temperate, sub tropical and tropical regions.

(<http://www.fao.org/3/w1808e/w1808e0c.htm>)

Climate Resilient Millets grown in 131 countries. Ancient food grains first plants domesticated for food - Earliest evidence found in Indus civilization dates back to 3000 BC : Millets traditional food for 59 crore people in Asia & Africa.



Pearl Millet
(**Bajra**)



Sorghum
(**Jowar**)



Finger Millet
(**Ragi**)



Foxtail Millet
(**Kangni**)



Kodo millet



Little Millet
(**Kutki**)



Proso Millet
(**Cheena**)



Barnyard Millet
(**Sawan**)



Browntop millet



Teff millet

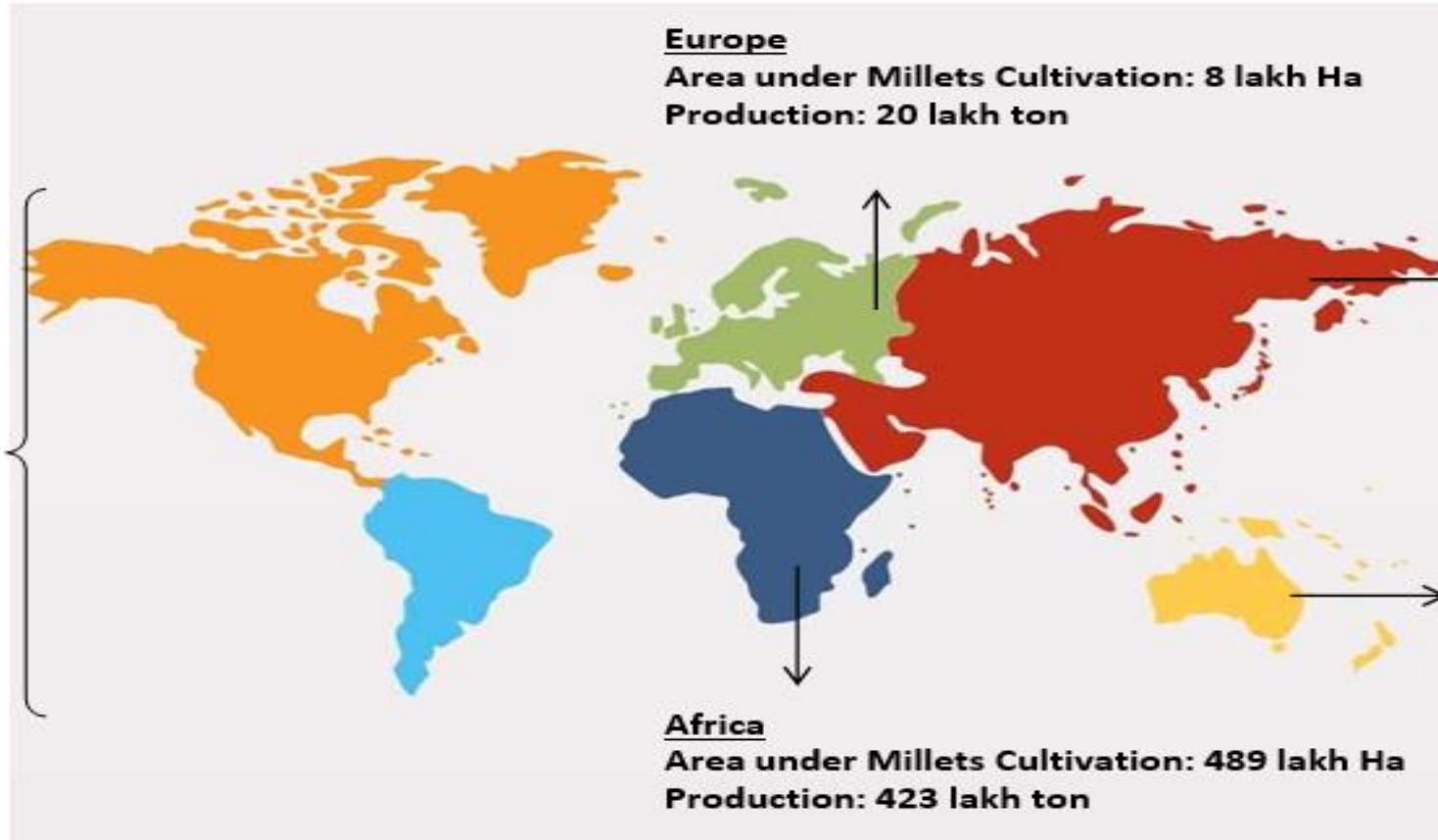


Fonio millet

GLOBAL SCENARIO



Americas
Area under Millets Cultivation: 53 lakh Ha
Production: 193 lakh ton



Asia
Area under Millets Cultivation: 162 lakh Ha
Production: 215 lakh ton

Australia & New Zealand
Area under Millets Cultivation: 6 lakh Ha
Production: 12 lakh ton

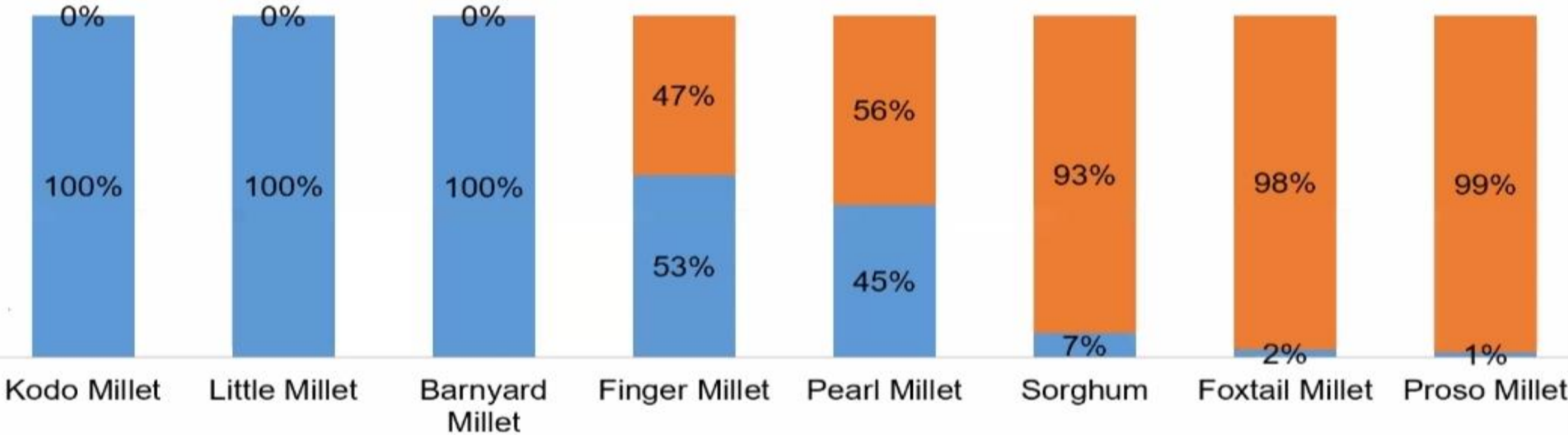
Europe
Area under Millets Cultivation: 8 lakh Ha
Production: 20 lakh ton

Africa
Area under Millets Cultivation: 489 lakh Ha
Production: 423 lakh ton

Source: FAOSTAT 2021

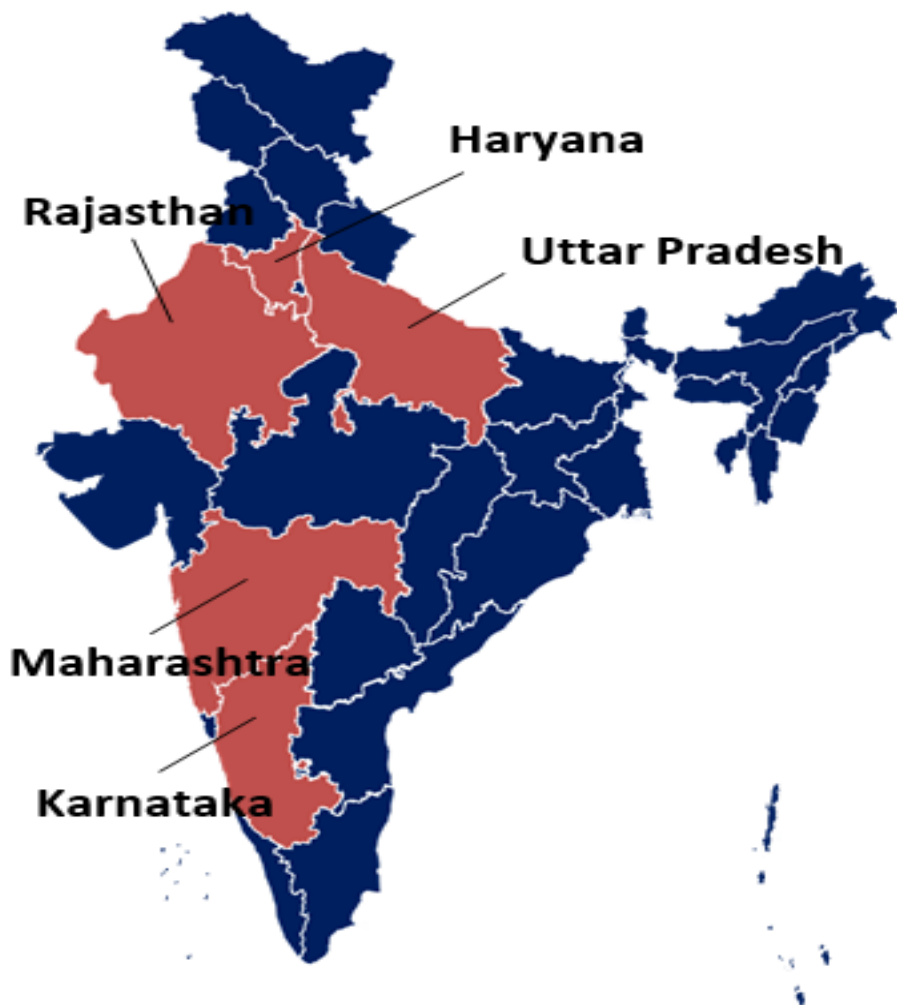
Percent Contribution of India to World Millet Production

■ India ■ Rest of the World



Source: IIMR estimate based on FAO/DES-GOI data

INDIA SCENARIO



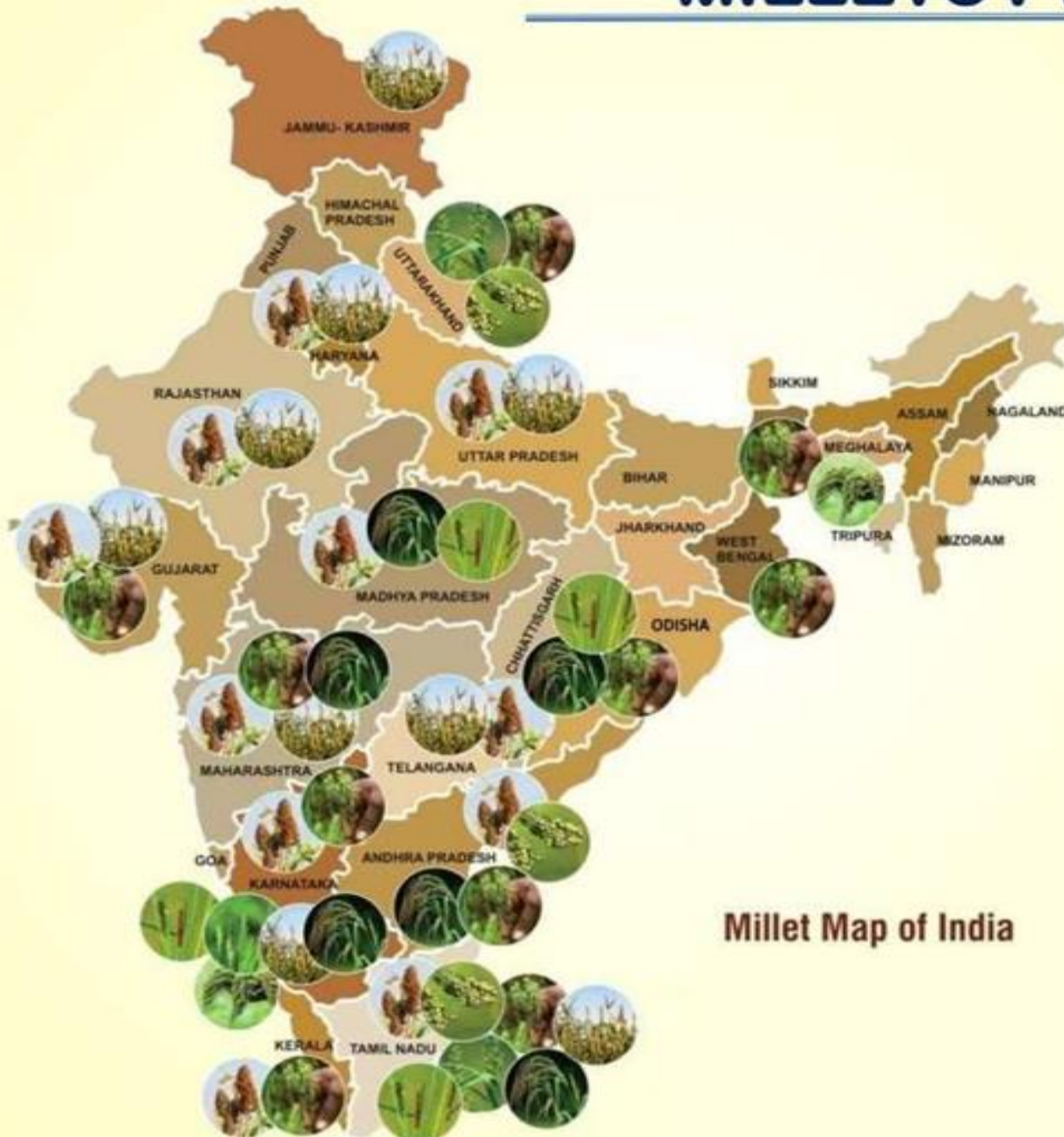
Top 5 Millet Producing States in India

Sr. No.	Name of Millet	Production (million tons) 2020-21	% contribution to total millets produced
1	<u>Bajra</u> (Pearl Millet)	10.86	60.5%
2	<u>Jowar</u> (Sorghum)	4.78	26.6%
3	<u>Ragi</u> (Finger Millet)	1.96	10.9%
4	Small Millets	0.35	1.9%
5	Total	17.95	

Source: Directorate of Economics & Statistics, DA&FW

- **India produces 80% of Asia's & 20% of global production**
- **Global average yield: 1229 kg/ha, India (1239 kg/ha)**

MILLETS : THE NUTRI-CEREALS



Millet Map of India



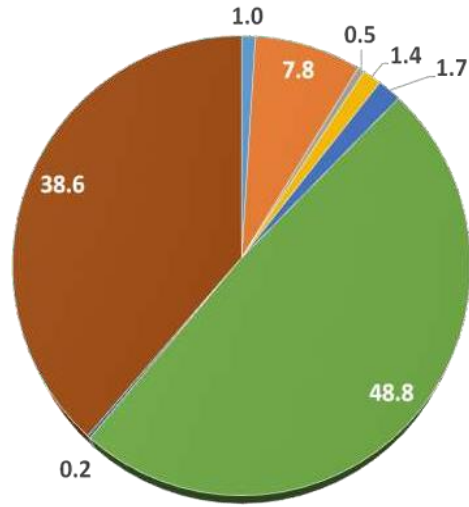
- Earliest evidence found in Indus civilization : 3000 BC.
- Ancient food grains first plants domesticated for food.
- Grown in 131 countries. Millets traditional food for 59 crore people in Asia & Africa.

Millets are collective group of small seeded annual grasses that are grown as grain crops, primarily on marginal land in dry areas of temperate, sub tropical and tropical regions.

<http://www.fao.org/3/w1808e/w1808e0c.htm>

Top 5 States	Millet Crops
Rajasthan	Bajra/Sorghum
Karnataka	Jowar/Ragi
Maharashtra	Ragi/Jowar
Uttar Pradesh	Bajra
Haryana	Bajra

Area (%) under each millet in India

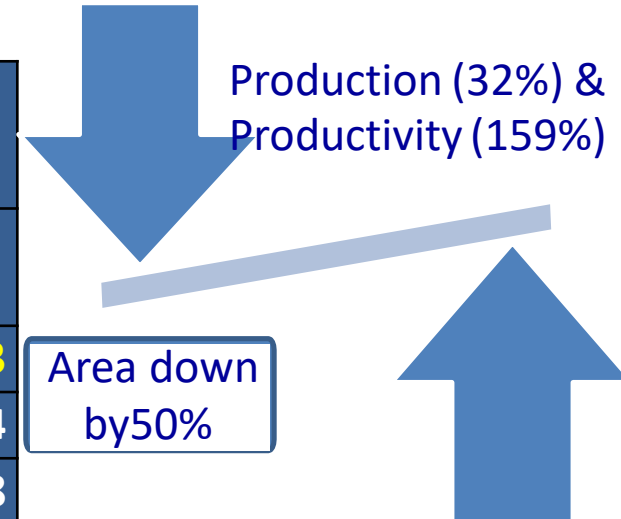


- Barnyard millet
- Finger millet
- Foxtail millet
- Kodo millet
- Little millet
- Pearl millet
- Proso millet
- Sorghum

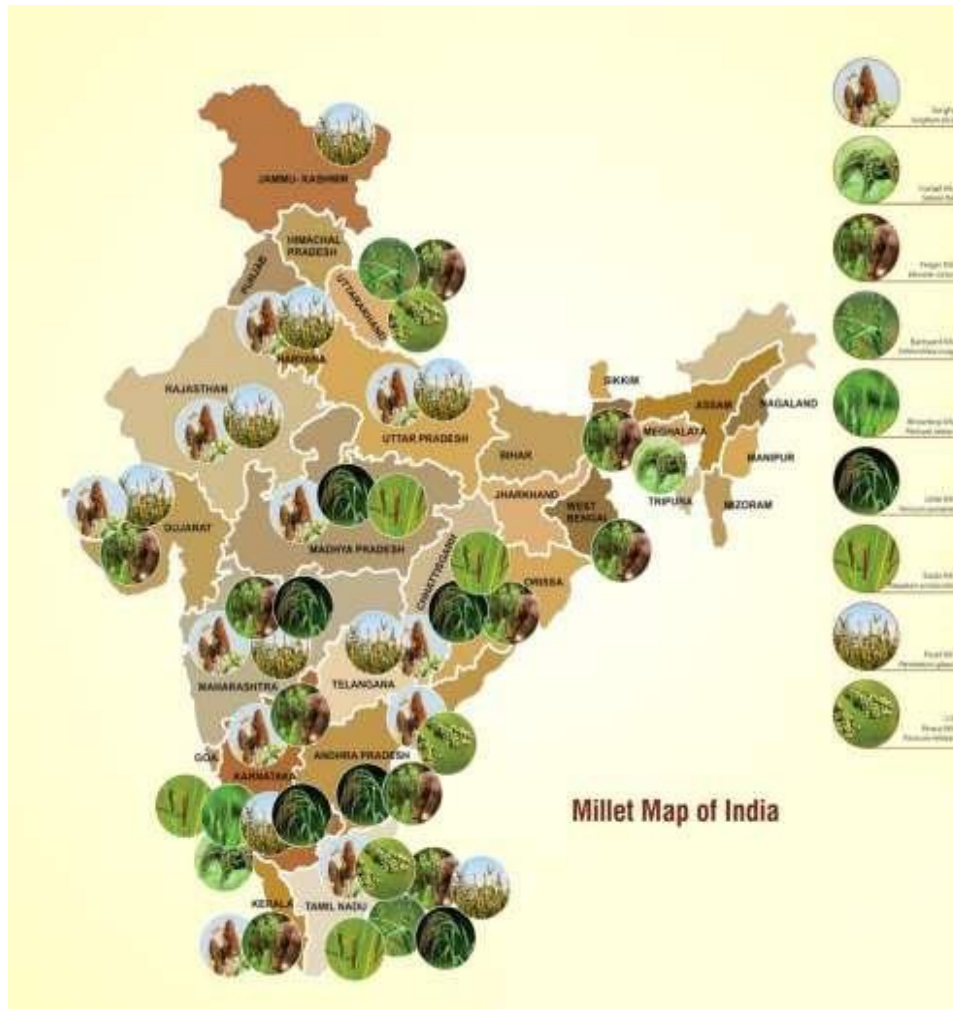
Source: Estimates based on data from Directorate of Economics and Statistics, Department of Agriculture & Cooperation, Government of India.

Area & productivity of millets in India

Crop	Area (lakh ha)			Productivity (kg/ha)		
	1955-56	1985-86	2021-22	1955-56	1985-86	2021-22
Sorghum	173.6	161.0	61.8	387	715	863
Pearl millet	113.1	106.5	72	302	344	1214
Finger millet	23.1	24.0	11.1	800	1049	1428
Small millets	53.4	31.6	7.5	388	386	571
Total millets	363.4	323.1	152.4	387	545	1055
% share in total cereals	42	31	13			



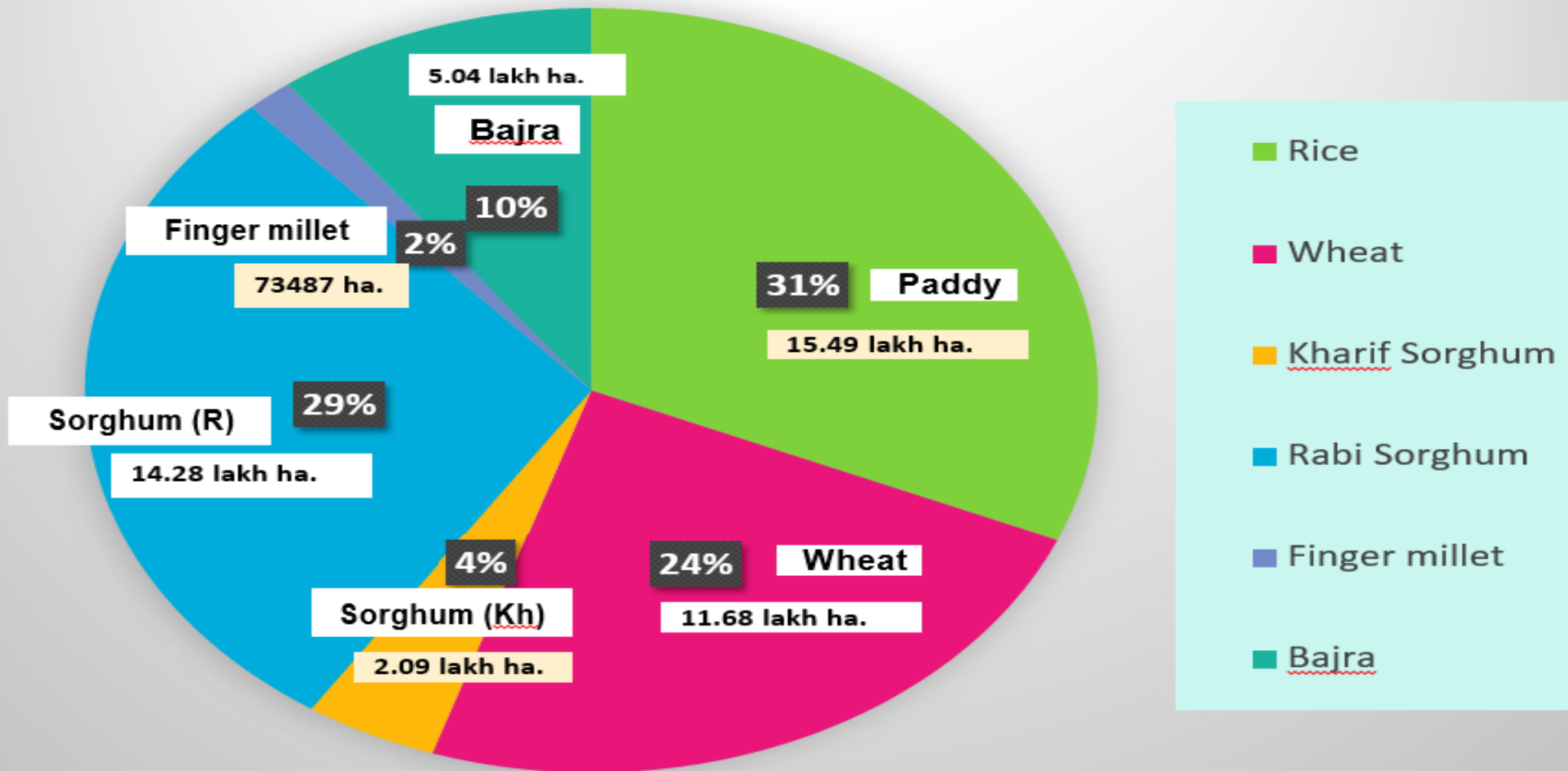
Small Millets growing states in India



Crop	Major growing states
Finger millet	Karnataka, Maharashtra, Uttarakhand, Tamilnadu, Andhra Pradesh., Jharkhand, Orissa , Chattisgarh, Gujarat and Telangana
Little millet	Karnataka, Maharashtra, Tamilnadu, Andhra Pradesh , Madhya Pradesh, Jharkhand, Orissa, ,Gujarat and Chattisgarh
Kodo millet	Madhya Pradesh, Chattisgarh, Maharashtra, Tamilnadu, Karnataka
Barnyard millet	Uttarakhand, Uttar Pradesh, Karnataka, Madhya Pradesh., North East and Tamilnadu
Foxtail millet	Telangana, Andhra Pradesh., Karnataka, Rajasthan, Madhya Pradesh, Tamilnadu and Chattisgarh
Proso millet	Bihar, North East, Tamil Nadu, Karnataka and Maharashtra.
Brown top millet	Karnataka, Andhra Pradesh, Telangana, Tamilnadu, Chattisgarh

Per centage of Cereal crop area in Maharashtra

Millets Area (00 ha) in Maharashtra (2021-22)



Reason of low production and demand of millets

Supply side

- ✓ Traditional crops, low profit and less productivity
- ✓ Absence of infrastructure for primary processing
- ✓ Not cultivated as a major crops

Demand side:

- Very low demand and less consumption as a staple food
- Lack of awareness about nutritional benefits
- Changing lifestyle, Food habit

Policy side:

- ❑ PDS, ICDS, MDM
- ❑ Green revolution: Focus on Rice and Wheat

USP of Millets

Production side

- **Dry land Crop**; Short Duration & Grows well in marginal
- **Low Water** & Minimal Purchased Inputs but **Responsive to High Input Management**
- Resilience to **Climate Change** (C4 plant) & Ideal Contingent Crop
- Sustainable & Potential *Future Crop*
- Potential to offer **Food, Fodder, Nutritional, Health & Fuel Security**



Demand side

- **Nutricereals**- rich in Minerals & Vitamins, Dietary fibre and Anti Oxidant
- Possess **Health benefits**,
- Now technologies for RTC/ RTE foods available
- Offers as **Functional food & Nutraceutical** source

1- Farmer

2- Nutritious food for all

3- For environment

Good for YOU - Nutritional Value of Millets



Grain (Millet /Cereal)	Carbo-hydrates (g)	Protein (g)	Fat (g)	Energy (Kcal)	Dietary Fibre (g)	Ca (mg)	Mg (mg)	Zn (mg)	Fe (mg)	Thiamin (mg)	Riboflavin (mg)	Niacin (mg)	Folic acid (µg)
Sorghum	67.7	10.0	1.7	334.1	10.2	27.6	133.0	2.0	4.0	0.4	0.1	2.1	39.4
Pearl Millet	61.8	11.0	5.4	348.0	11.5	27.4	124.0	2.8	6.4	0.3	0.2	0.9	36.1
Finger millet	66.8	7.2	1.9	320.7	11.2	364.0	146.0	2.5	4.6	0.4	0.2	1.3	34.7
Kodo millet	66.2	8.9	2.6	331.7	6.4	15.3	122.0	1.7	2.3	0.3	0.2	1.5	39.5
Proso millet*	70.4	12.5	1.1	341.1	-	14.0	153.0	1.4	0.8	0.4	0.3	4.5	-
Foxtail millet*	60.1	12.3	4.3	331.0	-	31.0	81.0	2.4	2.8	0.6	0.1	3.2	15.0
Little millet	65.6	10.1	3.9	346.3	7.7	16.1	91.4	1.8	1.3	0.3	0.1	1.3	36.2
Barnyard millet*	65.6	6.2	2.2	307.1	-	20.0	82.0	3.0	5.0	0.3	0.1	4.2	-
Wheat	64.7	10.6	1.5	321.9	11.2	39.4	125.0	2.9	4.0	0.5	0.2	2.7	30.1
Rice	78.2	7.9	0.5	356.4	2.8	7.5	19.3	1.2	0.7	0.1	0.1	1.7	9.3

Source: Indian Food Composition Tables, 2017, National Institute of Nutrition

Thus, no doubt Millets are Smart Foods

Why Millets need promotion?

- Millets are climate resilient crops
- Millets are adapted to smallholder production systems
- Millets are nutri-rich
- Millets are nearly organic foods and ecofriendly crops
- High yielding cultivars available in millets
- Millets' products have multiple uses
- Millets provide quality green forage and dry fodder

How to enhance the farmers' income?

- ❑ **By increasing productivity**
- ❑ **By reducing cost of cultivation**
- ❑ **By increasing marketing opportunities**
- ❑ **Sustainable value chain through group approach**

Prominent Millets Technologies

1. Use of high yielding cultivars
2. Improved practices and timely management
3. Water conservation practices
4. Millets-based inter cropping
5. New niches of millets cultivation
6. Primary processing and value-addition
7. Mechanization
8. Promotion of bio-fortified cultivars
9. Sustainable millets production and value-chain through FPOs
10. Promotion of allied enterprises



भारतीय कृषि अनुसंधान परिषद द्वारा विकसित
बायोफोर्टिफाइड (जैवसंवर्धित) किस्में



बाजरा

एचएचबी-299 :

आयरन : 73 पीपीएम
जिंक : 41 पीपीएम
81 दिनों में पकता है।

आरएचबी 234

आयरन : 84 पीपीएम
जिंक : 46 पीपीएम
81 दिनों में पकता है।

एएचबी-1200 एफई :

आयरन : 73 पीपीएम
78 दिनों में पकता है।

एएचबी-1269 एफई :

आयरन : 91 पीपीएम
जिंक : 43 पीपीएम
82 दिनों में पकता है।

सामान्य किस्म

आयरन : 45 से 50 पीपीएम
जिंक : 30 से 35 पीपीएम

नरेन्द्र सिंह तोमर
कृषि एवं किसान कल्याण मंत्री, भारत सरकार

AHB 1200 Fe (2017):



Significant Achievements

- Notification No. S. O. 1379 (E) dated 27/03/2018
- Higher grain yield (2912 kg/ha)
- Higher Iron content-88 ppm
- Higher Zinc content 41 ppm
- Medium maturity (80-85 days)
- Resistant to Downey mildew
- Suitable grain hybrid for food supplements for anemic children and adults
- Very compact ear head, bold, globular and gray coloured grains
- Released and Notified at National Level



AHB 1269 Fe (2018)

- Notified in the 80th Meeting of Central Notification Committee
- **High grain and Stover yield**
- **High-Fe (91ppm)**
- **High Zn (45 ppm)**
- Suitable grain hybrid for food supplements for anemic children and adults
- **Bold grain, medium maturity (81 days)**
- **Compact ear head**
- **Downy mildew resistant hybrid**
- **Released at National Level**



VNMKV- NARP, Aurangabad received **Best ICAR- AICRP on Pearl Millet Centre for 2022-23** at ICAR-IIMR, Hyderabad on 11th July, 2023 during 61st AGM for significant contribution in Pearl Millet improvement in Zone B from ICAR- AICRP on Pearl Millet

राष्ट्रीय कृषि संशोधन प्रकल्प

पैठण रोड, औरंगाबाद.

राष्ट्रीय कृषि संशोधन प्रकल्प, पैठण रोड, औरंगाबाद

जैविक कीड-रोगनाशके व जैविक खते निर्मिती प्रयोगशाळा

► ट्रायकोटर्मा ► बायोपिस्मा ► अमिलना ► पीएचबी ► बिन्दोरिया ► जैविक संप
► मुंबोथोनास ► मिसिथोयापॉसिस ► पेट्टावर्कटिप्य ► ट्रायकोकार्ड ► गण्डोविषय



Felicitation by Dr. Indra Mani Sir, Hon. Vice-Chancellor VNMKV, Parbhani

Pearl Millet Hybrid released and under active seed chain

Sr	Name of Hybrid	Year of Rele	Area of Adaptation	Duration Group	Yield (kg/ha)	
					Grain	Fodder
1	GHB-905	2013	Zone A (<i>Kharif</i>)	Medium	3200	7800
2	GHB 1225	2019	For Gujarat (<i>Kharif</i>)	Late	3023	7306
3	GHB 1129	2019	For Gujarat (<i>Kharif</i> and summer)	Medium	K-2957 S-5303	K-6210 S-9179
4	GHB 1231	2020 2021	For Gujarat (<i>Kharif</i>), Summer and Pre-Rabi)	Late	K-2916 S-5737	K-7545 S-8193
5	GHB-538 Improved	2021	For Gujarat (<i>Kharif</i>)	Early	2600	6300

Varieties of Bajra (MPKV, Rahuri)

Sr. no.	Variety	Release year	Soil type	Maturity (Days)	Yield (Q/ha)
1	<u>Shraddha</u>	1990	Light to medium	70 to 75	25 to 27
2.	<u>Shanti</u>	2006	Light to medium	80 to 85	30 to 31
3	<u>Phule Dhanshakti</u>	2012	Light to medium	74 to 78	20 to 22
4.	<u>Phule Adishakti</u>	2015	Light to medium	80 to 85	32 to 34
5.	<u>Phule Mahashakti</u>	2017	Light to medium	85 to 90	29 to 30

Phule Rohini (RPASV 3)



Release year	2015
Name of Institute / University	Sorghum Improvement Project, MPKV, Rahuri
Soil type	Medium – Deep soil
Climate	Rabi Season
Sowing Time / Planting period	15 th September to 15 th October
Seed Rate (Per acre)	4 kg/ Acre
Crop duration	115-120 days
Productivity	Grain Yield : 18-20 q/ha. Fodder Yield: 45-50 q/ha.
Characters / features	Red grain, Tolerant to shoot fly, Tolerant to Charcoal rot, Tolerant to drought

Phule Yashomati (RSV 1910)



Release year	2021
Name of Institute / University	Sorghum Improvement Project, MPKV, Rahuri
Soil type	Shallow soils
Climate	Rabi Season
Sowing Time / Planting period	15 th September to 15 th October
Seed Rate (Per acre)	4 kg/ Acre
Crop duration	112-115 days
Productivity	Grain Yield : 9.2 q/ha. Fodder Yield: 42.6 q/ha.
Characters / features	Pearly white, medium bold and round grain, Tolerance to shoot fly and stem borer, Moderately resistant to Charcoal rot and foliar diseases (rust and leaf blight)

Phule Purva (RSV 2371)



Release year	2022
Name of Institute / University	Sorghum Improvement Project, MPKV, Rahuri
Soil type	Deep soils
Climate	Rabi Season
Sowing Time / Planting period	15 th September to 15 th October
Seed Rate (Per acre)	10 kg/ Acre
Crop duration	118-121 days
Productivity	Grain Yield : 20-25 q/ha. Fodder Yield: 65-70 q/ha.
Characters / features	Variety is non lodging ideotype and can be suitable for mechanical harvesting & good for grain and fodder yield, tolerant to shoot fly, drought purpose Charcoal rot & medium bold, pearly white colour, lustrous grain

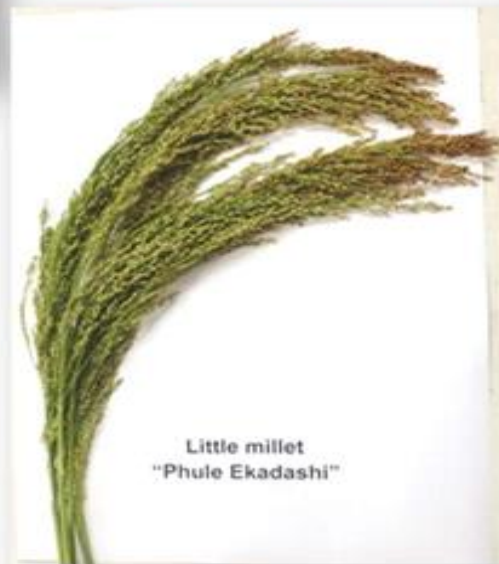


Parbhani Shakti (PVK 1009)

List of improved varieties released for cultivation in India

State	Varieties
Finger millet	
Karnataka	DHFM-78-3, Vakula (PPR 2700), Arjuna (OEB-526), VL Mandua 376 (VL 376), VL Mandua 352 (VL 352), GPU 67, GPU 66, GPU 48, GPU 45, GPU 28, PR 202, MR 1, MR 6, Indaf 7, ML365, KMR 340, KMR 301, KMR 204, KMR 360
Maharashtra	VL Mandua 376 (VL 376), Phule Nachani 1 (KOPN 235), KOPLM 83, Dapoli 1, Dapoli 2
Foxtail millet	
Karnataka	DHFt 109-3, HMT 100-1, SiA 3156, SiA 3088, SiA 3085, SiA 326, PS 4, Narasimharaya, HN-46
Little millet	
Karnataka	DHLM 36-3, DHLM 14-1, Chhattisgarh Kutki 1 (BL-6), OLM 203, JK 8, LMV 518, BL-41-3
Maharashtra	Chhattisgarh Kutki 1 (BL-6), Phule Ekadashi (KOPLM 83), JK 8, OLM 203, DHLM 36-3, DHLM 14-1, LMV 518
Proso millet	
Karnataka	ATL 1 (TNPm 230), DHPM-2769, GPUP 8, GPUP 21, TNAU 145, TNAU 151, TNAU 164, TNAU 202
Kodo millet	
Karnataka	GPUK 3, RBK 155, RK 390-25, TNAU 86, ATL-2, BK-36
Kodo millet	
Karnataka	GPUK 3, RBK 155, RK 390-25, TNAU 86, ATL-2, BK-36

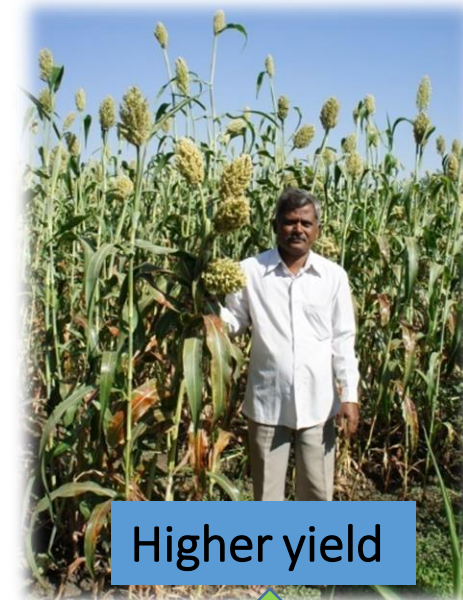
Varieties Released: Small millets, ZARS, Kolhapur



Package of practices for higher yield of millet



Selection of good variety



Higher yield



Seed Treatment



Sowing of Seed & Fertilizer



Maintain plant population



Production Technology

Particulars	Kharif Sorghum	Rabi Sorghum	Pearl Millet
Major states	Maharashtra, Karnataka, Andhra Pradesh, MP	Maharashtra, Karnataka, Andhra Pradesh, Tamilnadu	Maharashtra, Rajasthan, Gujrat, Haryana, Punjab, Delhi, Tamilnadu, Uttar Pradesh
1) Season	Kharif	Rabi	Kharif
2) Sowing time	15 June – 15 July	1 – 15 October	15 June – 15 July S- 15 January to 7 February
3) Seed rate (kg/ha) (transplanting)	10 kg/ ha	10 kg/ ha	2.5 kg / ha
4) Seed treatment	<i>Thirum</i> 3 g / kg <i>Thiamethoxam</i> 3 g / kg	<i>Imadachlopride</i> 70 % 3 g / kg	<i>Metalaxyl</i> 4- 6 g / kg
5) Biofertilizers		<i>Azospirillum & PSB</i> 10-15 g /kg	<i>Azospirillum & PSB</i> 10-15 g /kg
6) Spacing	45 x15 cm	Rainfed 45 x15 cm Irrigated 45 x10 cm	45 x 10 cm
7) Sowing depth	3-4 cm	5 cm	3 – 4 cm
8) Thinning	After 15-18 days	After 15-18 days	After 15 days
9) Fertilizer dose	80 : 40 : 40	1) 40 : 20 : 20 – Rainfed 2) 80 : 40 : 40 – Irrigated	40- 60 kg N / ha in two split doses 30- 40 kg P ₂ O ₅ as a Basal dose
10) Irrigation (critical stages)	1) Seedling stage 2) Flowering stage 3) Grain filling stage	1) 30- 35 Days after sowing 2) 50-55 Days after sowing 3) 70-75 Days after sowing 4) 90-95 Days after sowing	1) Seedling stage 2) Grain filling stage
11) Maturity	110-115 Days	115-125 Days	80-85 Days
12) Productivity (Q/ha)	30-35 qt/ha	35-38 qt/ha	28- 32 qt/ha
13) Improved varieties	Varieties -PVK-801, PVK-809, Hybrids - CSH-25, SPH- 1641, CSH-14, CSH- 16, CSH- 35	Rainfed - Parbhani Moti, Parbhani Super Moti, Suchitra, Phule Vasudha, Irrigated - Parbhani Jyoti, Parbhani Super Moti, Phule Vasudha, Phulr	Population - AIMP- 92901, PPC-6, ABPC-4-3 Hybrids - AHB- 1666, Shanti, Shradha, Saburi, Bio fortified hybrids - AHB- 1200, AHB- 1269

Production Technology

Particulars	नाचणी (Finger millet)	वरई/ वरा (Little millet)	राळ (Foxtail millet)
Major states	Karnataka, Maharashtra, <u>Uttarakhand</u>	AP, MS, KR, TN, RJ	AP, MS, KR, TN, RJ
1) Season	<u>Kharif</u>	<u>Kharif</u>	<u>Kharif</u>
2) Sowing time	15 June to 15 July	15 June to 15 July	15 June to 15 July
3) Seed rate (kg/ha) (transplanting)	3.00 to 4.00	3.00 to 4.00	3.00 to 4.00
4) Seed treatment	<u>Carbendazim @ 2.00 g/kg</u>	<u>Carbendazim @ 2.00 g/kg</u>	<u>Carbendazim @ 2.00 g/kg</u>
5) Biofertilizers	<u>Azospirillum brasilense</u> and <u>Aspergillus awamori @ 25 gm/ kg</u>	<u>Azospirillum brasilense</u> and <u>Aspergillus awamori @ 25 gm/ kg</u>	<u>Azospirillum brasilense</u> and <u>Aspergillus awamori @ 25 gm/ kg</u>
6) Spacing	30.0 cm (row) x 10.0 cm (plant)	30.0 cm (row) x 10.0 cm (plant)	30.0 cm (row) x 10.0 cm (plant)
7) Sowing depth	1.00 to 1.50 cm	1.00 to 1.50 cm	1.00 to 1.50 cm
8) Thinning	25 to 30 DAP	25 to 30 DAP	25 to 30 DAP
9) Fertilizer dose	60:30:30 N, P ₂ O ₅ K ₂ O kg/ha	40:20:20 N, P ₂ O ₅ K ₂ O kg/ha	40:20:20 N, P ₂ O ₅ K ₂ O kg/ha
10) Irrigation (critical stages)	1) <u>Tillering phase</u> 2) Flowering 3) Grain filling	1) <u>Tillering phase</u> 2) Flowering 3) Grain filling	1) <u>Tillering phase</u> 2) Flowering 3) Grain filling
11) Maturity	95 to 120 Days	85 to 130 Days	70 to 90 Days
12) Productivity (Q/ha)	20 to 25	15 to 20	15 to 25
13) Improved varieties	<u>P.Nachani</u> , <u>P.Kasari</u> , Dapoli-3	<u>P.Ekadashi</u> , <u>Kokam Satvik</u>	PDKV <u>Yashshree</u>

Major points for increasing productivity of small millets

- 1) Crops responsive to inputs
- 2) Seed treatment and use of high yielding varieties
- 3) Timely transplanting
- 4) Planting in rows (30.0 x 10.0 cm)
- 5) Weed management and irrigation at critical stages
- 6) Pest and disease control



Insitu soil and water conservation Practices to be adopted before commencement of rains

➤ Preparation of square basins (20 x 20m)



With the help of tractor operated plough prepared the square basins of 20 x 20m

- Increase in soil moisture by 13 to 62 %**
- Conservation of soil and nutrients**

Bunding for shallow to medium deep soils

Recommendation domain: Solapur, Ahmednagar, Western part of Beed, Osmanabad, Aurangabad, Eastern part of Pune, Sangli, Southern part of Dhule, Jalgaon and Jalna in Maharashtra.

- **Size 6x6 m to 10x10 m.**
- **Ridge height 20 to 30 cm**

Performance: The practice of compartment bunds conserved 35% more moisture than farmer practice (two harrowings only) and increased grain yield of *rabi* sorghum is to the tune of 2.0 q / ha. **with B:C ratio 1.83**



Contour Cultivation with opening of ridges and furrows



- Yield > 38.82% (Jowar), 50% (Cotton)
 - RWUE > 33.57% (Jowar),
> 47.37% (Cotton)
 - Soil moisture > 27.06%, (J.), 71.42% (C.)
 - **Runoff**
 - **Soil loss**
 - **Nutrient loss**
- } upto 100%

Cost per ha – Rs. 5300/- (Addi.)

Effect on Soil Properties

Reduction in-

- Bulk Density, mg/m^3 – $1.39 < 1.30$
- Soil Resi., KPa –
 - $3264 < 2145$ (0-15cm depth)
 - $3288 < 2259$ (15-30cm depth)

Increase in-

- Field Cap., % - $29.10 > 31.30$

Opening of continuous furrows 30 days after sowing retained higher soil moisture during dry spell, enhanced rain water productivity and increased yield of sorghum and cotton. This can be adopted by farmers using traditional tools.

Sorghum cultivars according to soil depths

Recommendation domain: Solapur, Ahmednagar, Western part of Beed, Osmanabad,
Eastern part of Pune, Sangli, Satara

➤ **Performance:**

Shallow soils (upto 30 cm) Selection-3, Phule Anuradha – **Increase in yield 15 % over F.P.**

Medium soils (upto 60 cm) Phule Maulee, Phule Suchitra, Maldandi 35-1 – **Increase in yield 20 % over F.P.**

Deep soils (60 cm and above) Phule Vasudha, Phule Yashoda, Phule Revati – **Increase in yield 25 - 30 % over F.P.**



Sorghum-M 35-1



Sorghum- Phule Anuradha



Sorghum -Phule Vasudha



Sorghum- Phule Maulee

Table.1 Grain yield, fodder yield, 100 grain weight, WUE and economics of *rabi* sorghum under different treatments (Pooled)

Treatment	Grain yield (kg/ha)	Fodder yield (kg/ha)	100 grain weight (g)	Total water use (mm)	WUE (kg/ha-mm)	GMR (Rs./ha)	NMR (Rs./ha)	B:C ratio
Irrigation Schedule:								
I ₁ - Drip at 1.0 ET _c	5767	8857	3.88	320.7	17.98	136080	103260	3.15
I ₂ - Drip at 0.75 ET _c	5378	8583	3.68	261.1	20.60	128030	95214	2.90
I ₃ - Drip at CGS	3988	6968	3.27	233.0	17.12	98810	65990	2.10
I ₄ -Surface at CGS	3349	6146	3.01	363.3	9.21	80781	58344	2.49
I ₅ - Rainfed	1592	3551	2.76	103.3	15.41	41438	23642	1.33
SEm ±	1.47	3.02	0.09	-	-	2745	2744	0.108
CD (P=0.05)	4.39	8.96	0.28	-	-	8142	8142	0.321
Variety:								
V ₁ -SPV 1595	3844	6702	3.40	-	-	93512	65773	2.25
V ₂ -AKSV 18R	4185	6940	3.24	-	-	100540	72805	2.51
SEm ±	0.93	1.91	0.06	-	-	1738	1735	0.069
CD (P=0.05)	2.77	NS	0.17	-	-	5149	5149	0.203
Interaction:								
SEm ±	2.09	8.86	0.13	-	-	3881	3881	0.153
CD (P=0.05)	NS	NS	NS	-	-	NS	NS	NS
Season x Treatment:								
SEm ±	6.74	29.65	9.19	-	-	-	-	-
CD (P=0.05)	NS	NS	NS	-	-	-	-	-
GM	4015	6823	3.34	-	-	97,027	69,290	2.39

Ridges and furrow for medium deep to deep soils

Recommendation domain: Solapur, Ahmednagar, Western part of Beed, Osmanabad, Aurangabad, Eastern part of Pune, Sangli, Southern part of Dhule, Jalgaon and Jalna in Maharashtra.

- Opening of ridges and furrows with Baliram plough across the slope after onset of monsoon i.e. first shower.
- The width of furrow – 45 to 50 cm.



Performance:

- Moisture conservation – 45 per cent more than local practice
- The *rabi* sorghum grain yield increased by 53 per cent (2.5 - 3 q/ha) over farmers practice (i.e. two harrowings only) **with B:C ratio 2.10**



Rainwater harvesting in Farm Pond and efficient utilisation

Recommendation domain: Solapur, Ahmednagar, Western part of Beed, Osmanabad, Aurangbad, Eastern part of Pune, Sangli, Satara, Southern part of Dhule, Nanadurbar, Jalna.

Performance:

- With supplemental / protective irrigation increased yield upto 30-40 per cent in *kharif* / *rabi* crops

Potential of the technology: with supplemental /protective irrigation to *kharif* / *rabi* crops during dry spell and majorly establishment



Hoeing

Recommendation domain: Solapur, Ahmednagar, Western part of Beed, Osmanabad, Aurangbad, Eastern part of Pune, Sangli, Satara, Southern part of Dhule, Nanadurbar, Jalna.

Performance:

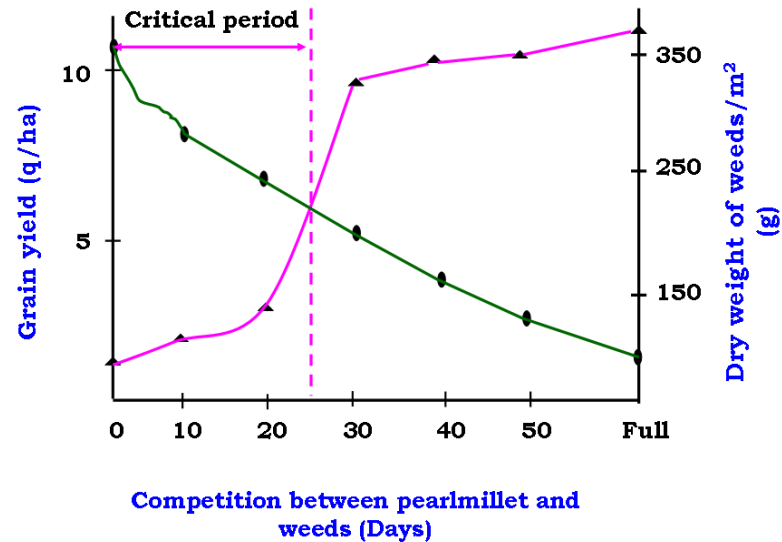
- Hoeing removes soil cracks and create dust mulch, Draft required for interculture is very less. Area covered 0.2 ha per day, reduce drudgery, in *kharif* for weed control and in rabi for moisture conservation and availability



Weed management

- Weeds cause 37-79 per cent loss to the crop production.
- It must be observed the critical period for weed control.
- In pearl millet 20-30 days from sowing of the crop is the critical period.

Fig. 1. Pearl millet yield and dry weight of weeds affected by competition- Solapur



- Some of the weed control practices like manual weeding, interculturing are found beneficial in dryland crops.

Selective herbicides for weed control in major dryland crops

Crops	Herbicides combination	Rate (kg/ha)	Time of application	Remarks
Sorghum	Atrazine fb 1 HW	0.25-0.5	PE	Broad spectrum control of annual grassy and broad leaved weeds
	Simazine	0.5-1.0	PE	
	Alachlor	1-1.5	PE	
	Isoproturon	0.5-0.6	PE	
		0.2-0.5	PE	
	0.5-1.0	PE		
Millets	Atrazine	0.2-0.5	PE	Mainly grassy weeds
	2,4-D	0.75-1.0	POST-E	To control <i>Striga</i> spp.

Scope & Hopes for Area expansion of Small millets in non-traditional season and non-traditional area of Maharashtra

- 1) Summer finger millet cultivation**
- 2) Sugarcane Intercropping**
- 3) Horticultural crops- Intercropping**
- 4) Cotton-Intercropping**
- 5) Finger millet as dual purpose (grain and fodder)**

Prominent millet intercropping systems of millets observed

Inter/mixed/strip Cropping	Ratio	States
Finger millet + pigeon pea	8-10: 2 6:2	Karnataka & Tamil Nadu, Bihar
Tansplanting of pigeon pea as intercrops In Finger millet	2:8	Chhattisgarh
Finger millet + Field bean	8:1 6:2	Karnataka & Tamil Nadu Bihar
Finger + Soybean	4:1	Karnataka
Finger millet + moth bean/ black gram	4:1 6-8:1	Maharashtra (Sub –montane region)
Finger millet + soybean (mixed cropping system)	90:10	Uttarakhand
Finger millet + Ground nut strip cropping	6:9	Karnataka

Cropping system	States
Sorghum + Pigeon pea(2:1)	Telangana, Marathwada, Vidarbha, Malwa Plateau, Parts of Gujarat
Pearl millet + Pigeon pea (2:1)	Telangana, Karnataka, Maharashtra, MP, Rajasthan, Haryana, Tamilnadu
Cotton + Sorghum + pigeon pea	Maharashtra
Pearl millet + green gram	Rajasthan, Haryana
Finger millet + Soybean(4:1)	Karnataka, Jharkhand
Finger millet + Field bean(8:1)	Karnataka
Castor + Finger millet(1:2)	Karnataka
Cowpea + Finger millet	Karnataka
Rabi season	
Black gram + sorghum	Karnataka, Maharashtra, Madhya Pradesh

Millet sequence cropping found in different parts of country

Sequence cropping	State
Sorghum - chickpea	Karnataka, Maharashtra, Madhya Pradesh, Rajasthan
Sorghum- wheat	Punjab
Sorghum- safflower	Karnataka
Black gram- sorghum	Karnataka, Maharashtra
Ground nut - sorghum	Karnataka
Pearl millet- wheat	Haryana
Pearl millet - chickpea	Haryana, Uttar Pradesh
Pearl millet – cluster bean	Haryana
Pearl millet – cluster bean/ moth bean/ mung bean	Rajasthan
Pearl millet- barley/ black gram	Jammu
Pearl millet-mustard	Rajasthan, Haryana
Groundnut–Potato–Pearl millet	Gujarath
Paddy- finger millet	Odisha, Madhya Pradesh
Foxtail millet- safflower	Karnataka

Intercropping of Pearlmillet + Pigeonpea (2:1) on medium deep black soils

Recommendation domain: Solapur, Ahmednagar, Western part of Beed, Osmanabad, Eastern part of Pune, Satara, Dhule

Performance:

Intercropping system gives more net monetary returns (Rs. 8000/ ha) over sole cropping of pearlmillet (Rs. 3000/ ha) with **B:C ratio 1.90**

Inter crop :

Intercropped with Tur in proportion of 3:3 or 4:2 rows or Soybean in 2:4 or 3:6 rows.



Sorghum effected by short periods of heat / drought stress which resulted into lower seed set and lower seed number.

- **Floret fertility decreased by short episodes (5 d) of stress.**
- **Maximum decreases during gametogenesis and fertilization.**
- **Grain weight was decreased during early rapid grain filling.**

Sensitive Stage :

If the temperature is about 40 degree Celsius for two days i.e. 10 days before anthesis and at anthesis in case of Pearl Millet

Crop protection



Shoot fly larvae



Dead heart symptom

Shoot fly: Seed treatment with Thiamethoxam 70% @ 3 g / kg seed. Cypermethrin 10% WS @ 10 ml or deltamethrin 2.8% WS @ 12.5 ml or chloropyriphos (20% WS@25ml / 10 lit.)

Stemborer : Cypermethrin 10% WS @ 10 ml or deltamethrin 2.8% WS @ 12.5 ml or chloropyriphos (20% WS@25ml / 10 lit.)

Grain mold: Harvest at physiological maturity, spraying of mancozeb 3g / lit. of water from flowering to physiological maturity at 10 days interval.



Plate 1. Shoot fly

Seed treatment: Thiamethoxam 30 FS @ 10 ml/kg
Spray: Cypermethrin 10 EC (750 ml/ha.) or
Quinolphos 25 EC (400 g a.i./ha)



Plate. 3. Pink borer

Application: Carbofuron 3 G granules in
whorls @ 8-12 kg a.i./ ha

Front Line Demonstration

	Aurangabad	Dhule
Area (ha)	10	10
No of Demonstration	25	25
Name of Hybrid	AHB 1200Fe	Adhishakti
Increasing in yield over farmers practices (%)		
Grain	26.12	17.45
Fodder	27.06	14.19

Progressive Bajra growing farmers



Shri.Nivrutti Kagde
Village :lakhegaon
Ave. Yield : 16 q/Acre



Shri. Ranjit Chungade
Village :lakhegaon
Ave. Yield : 13 q/Acre



Shri. Pandurang suryawanshi
Village :Khandala
Ave. Yield : 12 q/Acre



Shri. Ishwar Sapkal Village :Soygaon
Ave. Yield : 14 q/Acre

Shri. Nivrutti Kagade, farmer from village Lakhegaon was a beneficiary of FLD.

He took 2500 kg/ha yield. He was aware about nutritional content in AHB- 1200 Fe. So looking this nutritional benefit he sold his produce by making of 1-5 kg packets.

Maha Agro exhibition was organized during this year in NARP, Aurangabad campus and he sold 20 qt. seed to the consumers of

urban as well as rural people. Second most important thing is he

popularized such a wonderful hybrid in the vicinity of his

village. That's why demand for this hybrid for sowing as

well as nutritional purpose



Case Study

Primary Processing Machineries



Machinery for Primary Processing

Meet
Our Team



De-stoning cum Grader



Millet Mill



Single stage dehuller



Double stage dehuller

Advantages: Less labor required
De-hulling efficiency range - 50% to 70%

Value added products from Small millets

Ready-to-Eat millet foods (Express food)



- E.g. Poha mix, Veg Pulao mix, Upma mix
- RTE Little millet poha mix was developed by using parboiled little millet flakes and other seasoning items.
- Rehydration tests, nutritional parameters, sensory and shelf life was conducted.
- It was observed that the 1:1 ratio of (Mix and water) was good compared with other samples.



READY-TO-COOK FOODS BASED ON MILLETS



- Based on unpolished millets (little and foxtail)
- Healthier meal replacer for regular sambar rice/upma made out of fibre depleted polished rice/ wheat semolina.

Traditional Recipes Developed by IIMR



500 + recipes developed



Millet Adai



Millet Bhujia



Millet Khoja



Millet Methi Rice



Millet Haleem



Millet Burfi

Our Technology Repository



Puffing Technology



Flaking Technology



Baking Technology



Cold Extrusion Technology



Hot Extrusion Technology



Fortified Foods Technology



Instant Mixes Technology



Recipes

Factors for mainstreaming millets

1	Farmer/ producer	7	NGOs
2	FPC/ FPO	8	Farm implement, Machineries manufacturers
3	Purchasers/ market	9	<u>Mahabeej</u> / Seed Companies
4	State <u>Agril.</u> Department	10	MSME/ Processors
5	<u>Agril.</u> Universities/ Research Institutes	11	SHG
6	Other Govt. Departments	12	Media (Newspaper/ DD/ Radio)



“We”

THANK YOU ●●●●●

