

Millets : As Animal Feed and Fodder

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- **Millets, a family of variable small-seeded grasses, are classified based on their seed size as:**
- **Major millets-** include sorghum (jowar), pearl millet (bajra), finger millet (ragi)
- **Minor millets-** foxtail (kangni), little millet (swank), kodo millet (kodon/kodra), barnyard millet (samvatke chawal), porso millet (chena) and brown top millet (hari kangni).

Major Millets



Pearl millet/ *bajra*



Sorghum/ *jowar*



Finger millet/ *Ragi*

Minor Millets



Foxtail millet/ *Kangani*



Proso millet/ *Cheena*



Little millet/ *Kutki*



Kodo millet/ *Kodo*



Barnyard Millet/ *Samwatkae*



Brown top Millet/ *Hari Kangni*

- **“National Year of Millets – 2018” by Government of India with the support of ICAR**
- **“International Year of Millets -2023” by United Nations –FAO**
- **The Government accepted and announced to rename the “Millets” as “Nutri-cereals” and included them in the government flagship 'Poshan Abhiyan' to fight malnutrition and hidden hunger**

Area and production of Millets in India during 2022-23

Crop	Area (lakh ha)	Production (lakh. tons)
Bajra	73.16 (56.84%)	106.04 (62.16%)
Sorghum	39.52	43.18
Ragi	11.55	17.66
Small millets	4.48	3.70
Total	128.71	170.58

Millet: the multifaceted crops providing multiple securities

Ancient food grains and are first plants domesticated for food. They provide

- **Nutritional security:** Provides nutritional diversity and source of nutrition for people with special food needs especially for diabetic and people with gluten allergies. Highly enriched with minerals, dietary fibre and micronutrients especially Fe and Zn and thus, can control malnutrition and hidden hunger
- **Climate resilience:** Next generation climate resilient crops due to **low water requirement and high temperature tolerance** and are very well suited to dry land agriculture (**drought tolerant**). As they can withstand **higher temperatures**, thus, they are perfect choice as ‘**climate-smart cereals**’.
- **Water security:** As per the current situation of agriculture system especially Punjab, which is facing major problem of depleting underground water resources, millets are an option, as they **use almost 30 per cent less irrigation water** in comparison to paddy cultivation.
- **Environmental and Ecological security:** Rewarding yield, with minimum chemical fertilizers and pesticides use. So, it is also not adding to the adverse effect of chemicals on natural resources as well as human health. **No harmful gas emissions.**

HEALTH BENEFITS

- **Millets can help in tackling health challenges**
 - **Obesity- High in Dietary fibre** and antioxidants.
 - Prevent type 2 diabetes: **Low Glycemic index (GI)** of millet based product
 - Reducing blood pressure
 - Reduces risk of gastrointestinal conditions like gastric ulcers or colon cancer
 - Eliminate problems like constipation, excess gas, bloating and cramping
 - Probiotic feeding micro flora in our inner ecosystem
- **Cure the lifestyle problems** as they are **gluten-free**, have a **low glycemic index** (good source of nutrition for diabetic people) and are high in **dietary fibre**
- **Nutritional security:** Millets are **Nutri-cereals** that are **highly nutritious** and known to have high nutrient content which includes **proteins, essential fatty acids, dietary fibre, B-Vitamins and minerals** such as **calcium, iron, zinc, potassium and magnesium**.
- **Combat Malnutrition and Hidden hunger:** nutritional deficiency, especially among children and women.
- **Tackle Anemia:** Increasing **anaemia** in women and children due to iron deficiency can be controlled as bioavailability of iron and zinc from millets is better as compared to other cereals.

Inclusion in chicken diets

- According to a recent study, including up to **50% whole pearl millet grain** in the diet of **broiler chickens** does not negatively impact their performance. In fact, it has been found to significantly **improve their growth and feed efficiency** and in **layers, it shows additional benefits of eggs that contain higher omega-3 fatty acids.**
- Research indicates that substituting up to **50% of corn in layers' diets with sorghum** has similar effects on egg production rates.
- Additionally, a study found that broilers' body weight gain was not affected when millet replaced corn in their diets. **Pearl millet varieties have also demonstrated comparable results to corn in terms of metabolizable energy and digestible amino acids.**

Inclusion in ruminants' diets

- Millet grain viz. finger and pearl millets were evidently used to replace conventional grains, in the feed of small ruminants. An early study on **lactating and growing goats found that feed intake and milk production** were not affected by the replacement of corn with pearl millet.
- **In dairy cows, pearl millet grain can replace 10-30% of corn silage or maize grain with no deleterious effect on DM intake, milk yield, or milk composition.** A study done on cows observed that pearl millet grain could fully replace maize in high- supplement diets. Another study found that the processing of millet grain increases the digestibility of dry matter and dietary nutrients of grazing beef cattle during the dry season.
- Pearl millet feeding can reduce supplemental protein requirement when compared to corn-based diets.
- **Finger millet can substitute up to 25% of maize grain** without affecting weight gain, carcass yields, and immunity in commercial broiler diets.

Nutrient content of major Millets as compared to wheat, rice & maize

Crop	Protein (g)	Fat (g)	Ash (g)	Fibre (g)	Carbohydrate (g)	Energy (kcal)	Calcium (mg)	Iron (mg)	Thiamin (mg)	Niacin (mg)
Pearl Millet	11.8	4.8	2.2	2.3	67.0	363	42	11.0	0.38	2.8
Sorghum	10.4	3.1	1.6	2.0	70.7	329	25	5.4	0.38	4.3
Ragi	7.7	1.5	2.6	3.6	72.6	336	350	3.9	0.42	1.1
Maize	9.2	4.6	1.2	2.8	73.0	358	26	2.7	0.38	3.6
Wheat	11.6	2.0	1.6	2.0	71.0	348	30	3.5	0.41	5.1
Rice	7.9	2.7	1.3	1.0	76.0	362	33	1.8	0.41	4.3

Work at PAU

Recently released varieties of millets by PAU

Sr No.	Name of the variety	Year of release
Pearl millet		
	PHB 2884	2015
	PCB 165	2020
	PCB 166	2022
	PCB 167	2024
Sorghum		
	PSC 4	2015
	SL 45	2022
	SL 46	2023
Proso millet		
	Punjab Cheena 1	2024

Package of Practices for cultivation of pearl millet

Particulars	Bajra	
Suitability of the variety for the area	Irrigated areas of Punjab	
Selection of field/land preparation	It grows on all types of soils, but light soils are more suitable. Adequate drainage should be provided.	
Sowing time	July	
Seed rate/sowing method	The seed rate for grain is 1.0 - 1.5 kg per acre and 6-8 kg per acre for fodder . Sow the seed about 2.5 cm deep in rows 50 cm apart.	
Fertilizer doses and time of fertilizer application	Under irrigated conditions: Urea- 90 kg, DAP-55 kg, SSP- 150 kg	Under rainfed conditions: Urea- 55 kg, DAP- 27kg, SSP- 75 kg
Weed control	Inter-culture the crop 3-4 weeks after sowing	
Major disease and pest control	Downy mildew- Resistant Grain smut- Remove the diseased ears early in the season and destroy them. Ergot- Immerse seed in 10 % salt solution and remove the sclerotia and smut-balls by skimming. Then wash the seed in ordinary water and dry it thoroughly.	
Irrigation schedule	Two to three irrigations are sufficient. Avoid water logging. Soil drainage should be good.	
Harvesting	The grain crop matures in about 124 days.	
Grain yield	13.0 - 16.0 qtls. per acre	

Package of Practices for cultivation of sorghum

Particulars	Sorghum
Suitability of the variety for the area	Irrigated areas of Punjab
Selection of field/land preparation	It grows on all types of soils, but heavy soils are more suitable. Adequate drainage should be provided.
Sowing time	Last week of June
Seed rate/sowing method	The seed rate is 6-8kg per acre. Sow in rows 30cm apart.
Fertilizer doses and time of fertilizer application	Apply 35 kg Urea; 50kg SSP and 16 kg MOP at sowing Again 35kg urea after 40 days of sowing
Major disease and pest control	<i>Insect pests</i> Shoot fly: Treat seed with 10ml Slayer 30FS (thiomethoxam) per kg seed before sowing <i>Diseases:</i> Grain smut: Treat seed with Sulphur dust @ 4g/kg seed before sowing.
Irrigation schedule	Five irrigations are sufficient. Soil drainage should be good.
Harvesting	The grain crop matures in about 135 days.
Grain yield	7-8 qtls. per acre

Dual Purpose Bajra variety – PCB 165

State Release-2020



- Late maturing high green forage yielding variety with average GFY of 234.1 q/acre.
- Possesses better fodder nutritional characters especially the crude protein of 7.5 %.
- Higher grain yield of 12.8 q/acre.
- The grains possess high iron (55 ppm) and zinc content (35 ppm).
- The grains have good popping potential and suitable for value addition.

Character	PCB 165	PCB 164 (C)
Green Fodder Yield (q/acre)	234.1	209.0
Dry Matter Yield (q/acre)	43.8	25.9
Days to 50% flowering	73	48
Crude Protein (%)	7.5	4.9
In vitro DMD (%)	61.2	52.5
Plant height (cm)	252	207
Grain yield (q/acre)	12.8	11.0
Popping Yield (%)	89	83



Dual Purpose Bajra variety – PCB 166

State Release-2022

- Very late maturing high green forage yielding variety with average GFY of 282 q/acre.
- Possesses better fodder nutritional characters especially the crude protein of 8.5 %.
- Higher grain yield of 16.3 q/acre.
- The ear heads are long with average length of 63.8 cm.



Character	PCB 166	PCB 165 (C)	FBC 16 (C)
Green Fodder Yield (q/acre)	282	259	236
Dry Matter Yield (q/acre)	48	45	35
Plant height (cm)	281	251	236
Days to 50% flowering	89	72	62
Crude Protein (%)	8.5	7.6	5.9
In <i>vitro</i> DMD (%)	47.8	45.6	41.9
Grain yield (q/acre)	17.2	14.3	-

Forage Bajra variety – FBL 4/PCB 166

National Release (NORTH WEST & SOUTH ZONES)-2023

- High green forage yielding variety with average GFY of 436.0 q/ha and dry matter yield of 85.5 q/ha .
- Possesses better fodder nutritional characters especially the crude protein of 9.6 % and IVDMD 54.6 %.
- Tolerant to insect pests and diseases.



Grain Bajra variety – PCB 167 (GBL 5)

State Release-2024

- Early flowering and short in height than check
- Higher grain yield of 15.6 q/acre.
- The grains possess high iron (56 ppm) and zinc content (38 ppm).
- The grains have good popping potential and suitable for value addition.



Pearl Millet (Grain) variety - PCB 167

Characters	PCB 167	PCB 165 (check)
Grain yield (q/acre)	15.6	13.4
Plant height (cm)	198.0	255.0
Days to maturity	90	111
Reaction to major diseases	MR	MR
Crude Protein (%)	11.6	10.4
Resistant starch (%)	15.3	13.9
Popping yield (%)	92	89
Iron (ppm)	56.3	54.3
Zinc (ppm)	38.1	35.5



Fodder Sorghum Variety: SL 45

State Release-2022

- SL 45 has green forage yield of 271 q/acre.
- SL 45 is a late maturing variety which comes to 50 per cent flowering in **99 days**.
- SL 45 is resistant to **red leaf spot** and **moderately resistant to zonate leaf spot disease**; and **moderately resistant to shoot fly**
- SL 45 possesses better fodder nutritional quality especially the **crude protein (9.0%)** and **in-vitro dry matter digestibility**.
- This variety has low HCN content.



Character	SL 45	SL 44 (C)
Green Fodder Yield (q/acre)	271	220
Dry Matter Yield (q/acre)	67	47
Plant height (cm)	297	258
Days to 50% flowering	99	62
Disease reaction	MR	HS
Shoot fly reaction	MR	MS
TSS (%)	8.9	8.7
Crude Protein (%)	8.7	8.2
In vitro DMD (%)	46.9	45.1

Dual Purpose Sorghum Variety: SL 46

State Release-2023



- **SL 46** has **green forage yield** of 275 q/acre and is **resistant to red leaf spot** and **moderately resistant to zonate leaf spot diseases and shoot fly**.
- **SL 46** is suitable for value addition like **popping and flour products**
- The grains of **SL 46** have **high iron and zinc content**
- **SL 46** possesses better fodder nutritional quality especially the **crude protein (9.5%)** and **in-vitro dry matter digestibility** and has low HCN content.




Character	SL 46	SL 45 (C)
Green Fodder Yield (q/acre)	275	266
Dry Matter Yield (q/acre)	71	67
Plant height (cm)	307	303
Days to 50% flowering	92	97
Disease reaction	MR	MR
Shoot fly reaction	MR	MR
TSS (%)	9.5	9.0
Crude Protein (%)	8.5	8.3

Grain quality traits of different Millet Varieties


Grain traits	Sorghum		Pearl Millet		
	SL 46	SL 45	PCB 167	PCB 166	PCB 165
Crude protein (%)	12.6	12.1	11.7	10.4	10.4
Crude fat (%)	4.3	3.5	4.7	4.2	4.0
Crude fibre (%)	3.1	3.5	5.6	5.1	5.2
Minerals (%)	3.4	2.8	3.3	3.1	3.3

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PEARL MILLET FOR HEALTH AND NUTRITIONAL SECURITY




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**VALORIZATION OF PCB 165:
A DUAL PURPOSE BAJRA
VARIETY**



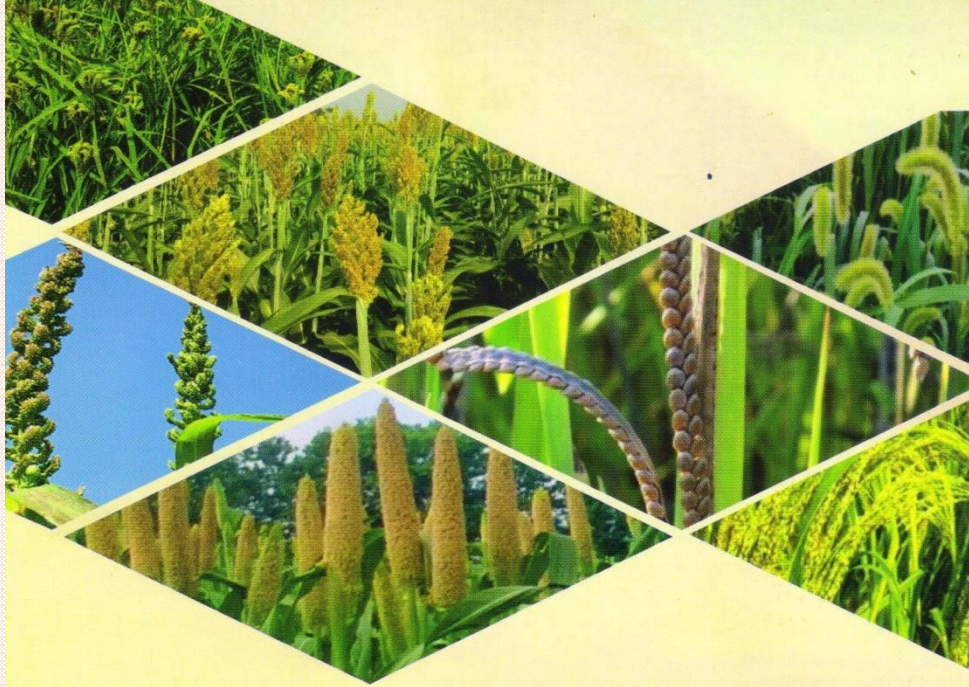
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2021

**FORAGE, MILLETS AND NUTRITION SECTION
DEPARTMENT OF PLANT BREEDING AND GENETICS**
in collaboration with
DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY

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Millets:

The Super Grain with Climate Resilience

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ਮਿਲਟਸ: ਗੁਣਵੱਤਾ ਨਾਲ ਭਰਪੂਰ ਰਿਵਾਇਤੀ ਫਸਲਾਂ

ਆਰ ਐਸ ਸੋਹੂ, ਰੁਚਿਕਾ ਭਾਰਦਵਾਜ,
ਰਾਜਨ ਸ਼ਰਮਾ ਅਤੇ ਸਵਿਤਾ ਸ਼ਰਮਾ

2022



ਚਾਰਾ, ਬਾਜਰਾ ਅਤੇ ਪੋਸ਼ਣ ਸੈਕਸ਼ਨ
ਪਲਾਂਟ ਬ੍ਰੀਡਿੰਗ ਅਤੇ ਜੈਨੇਟਿਕਸ ਵਿਭਾਗ
ਪੰਜਾਬ ਐਗਰੀਕਲਚਰਲ ਯੂਨੀਵਰਸਿਟੀ, ਲੁਧਿਆਣਾ

Preservation of Green Forage

Maintaining fodder requirement round the year

- Fodder requirement – 40-50 kg/day/animal
 - Maintaining good health of animals
 - Getting high milk yield
- Fodder availability- Surplus- Feb-March
- Aug-Sept
- Scarcity -May-June
- Nov-Dec
- Silage making- Non legumes
- Hay making - Legumes

Stage of cutting of Fodder crops

Crop	Stage of cutting
Maize	Milk ripe to dough stage
Sorghum	55-65 days after sowing
Bajra	Ear initiation stage

Silo Pit dimensions

- **3 m x 2.5 m x 2 m = 75 q fodder
(5 animals, 60 days, 25 kg/d)**
- **10 m x 5 m x 3 m = 450 q fodder
(10 animals, 6 months, 25 kg/d)**
- **Should be near the cattle shed.**
- **Should at a high surface of ground to avoid water logging conditions.**

Filling of silo-pit



Good / Bad silage

Characterstics	Well fermented	Poor fermented
Colour	Green yellow	Dark to brown
Smell	Vinegar	rancid
Texture	Firm	Slimy
pH	Below 4.5	5.0 or above
Taste	Pleasing	Offensive
Quality	Good	Poor

Mean silage quality

S.No.	Sample	pH	CP (%)	ADF (%)	NDF (%)	ASH (%)	IVDMD (%)
1	Sorghum	3.8	6.3	43.2	64.5	6.6	45.0
2	Bajra	4.3	6.0	43.6	63.2	6.7	43.7
3	Maize	3.7	6.2	37.4	67.3	5.6	45.8

Feeding of Silage of different Crops on Fresh and Dry Matter Basis

	Feed offered (Kg)	Residue left (kg)	Intake (kg)	% Intake	% DM Basis
Sorghum	26.57	4.62	21.95	82.61	80.85
Maize	25.37	2.84	22.53	88.79	87.57
Bajra	21.00	1.33	19.66	93.64	87.57

Percent nutrient digestibility of silage of different crops

Silage	% Nutrient Digestibility			
	% DM	% CP	% ADF	% NDF
Sorghum	54.83	67.22	49.33	57.42
Maize	55.41	61.59	45.69	56.87
Bajra	46.10	59.26	48.29	59.27

Conclusion

Millet-based feeds are useful to improve the nutritional value of animal products, including meat, milk, and eggs, thereby enhancing both animal health and human nutrition.

Continued research, policy support, and promotion are vital for maximizing the benefits of millets as a sustainable and nutrient-rich livestock feed and fodder resource. These efforts will overall contribute to creating a resilient agricultural systems in scarcity region

Government Policies

- MSP
- FPOs like Gurdaspur Organic Producer Company Ltd., and Start-ups, SHGs working to promote cultivation and processing of millets in Punjab.
- Primary processing units in Punjab, located in Batala, Jaito, Sangrur and Ludhiana.
- Mid-Day Meal Scheme



Pradhan Mantri Formalisation Of Micro Food Processing Enterprises

Credit Linked Subsidy

Entrepreneurship

Loan

Details [↗](#)

Launched on 29th June 2020, PMFMPE is a Centrally Sponsored Scheme by the Ministry of Food Processing Industries, designed to address the challenges faced by the micro-enterprises and to tap the potential of groups and cooperatives in supporting the upgradation and formalization of these enterprises.

Aims:

1. Enhance the competitiveness of existing individual micro-enterprises in the unorganized segment of the food processing industry and promote formalization of the sector; and
2. Support Farmer Producer Organizations (FPOs), Self Help Groups (SHGs), and Producers Cooperatives along their entire value chain.