

Recommended Varieties of Different Fodder Crops in Manipur

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Introduction

Livestock rearing in Manipur is a vital component of the state's agricultural system, providing milk, meat, and draught power, and serving as a crucial source of income and nutritional security for rural households (1). The state's unique geographical features, characterized by diverse topography, and its humid subtropical climate, present both opportunities and challenges for agricultural production (2). Despite the significant livestock population, as per the 2011 census, the sector is plagued by a chronic and significant deficit in fodder resources, particularly green fodder (3, 4). This shortage is a major bottleneck to achieving optimal animal health, reproductive efficiency, and overall productivity (5).

Fodder crops are not merely a source of nutrition for livestock; they are also integral to sustainable agricultural practices (6). They play a pivotal role in improving soil fertility through nutrient cycling, reducing soil erosion, and enhancing biodiversity when integrated into crop rotation and intercropping systems (7, 8). Addressing the existing fodder gap requires a multi-faceted approach, including improving the efficiency of existing grazing lands and promoting the cultivation of high-yielding, nutrient-rich, and climate-resilient fodder crop varieties (9, 10). The strategic promotion of these varieties is paramount to ensuring a stable and adequate supply of feed.

Historically, forests have been crucial for livestock management across the globe. Beginning in the Middle Ages, European farmers utilized tree and shrub leaves, as well as wild grasses, as essential fodder sources. For example, species such as European ash (*Fraxinus excelsior*), lime tree (*Tilia cordata*), and elm trees (*Ulmus spp.*) were vital for feeding livestock, including sheep, goats, horses, and cows, especially during the winter when conventional feed was scarce (10).

In mountainous regions, fodder plants remain a critical nutritional resource for livestock, particularly during the dry season when other food sources are limited. The nutritive value of these forage plants is directly linked to the optimal body size of herbivores, highlighting the importance of understanding nutrient content for both enhancing livestock productivity and informing wild herbivore conservation strategies. However, the nutritional quality of forage is often a neglected component of broader ecological and conservation studies (10).

At present, natural grasslands and rangelands, which are crucial ecosystems for forage diversity, are facing a rapid decline. The conversion of natural pastures and marginal lands to crop production areas is a primary driver of this trend. This rapid erosion of vital forage resources underscores the necessity of ex-situ conservation to safeguard forage genetic resources. Ultimately, cultivating forage crops in mixed-species systems can provide a sustainable source of nutrition for livestock without further depleting natural ecosystems (9,10).

This chapter provides a detailed overview of the key characteristics of recommended annual and perennial fodder crops, serving as a guide for their effective utilization in Manipur's diverse agro-climatic conditions to meet the growing demands of the livestock population.

2. Manipur's Livestock and Fodder Deficit

Manipur's livestock sector faces significant challenges. The total livestock population, which includes cattle, buffalo, mithun, yak, sheep, and goat, is 342.3 thousand. Despite this large population, the state has a severe deficit in green fodder availability, with only 58.6% of the required amount being available, resulting in a 41.4% deficit. This shortage is compounded by the minimal area under fodder cultivation, with only 0.04 hectares designated for this purpose, primarily on marginal land. Consequently, this scarcity of fodder directly impacts milk production, as the state produces only 79 thousand tonnes of milk against a requirement of 95.27 thousand tonnes, leading to a milk deficit of 16.27 thousand tonnes, or 17.08%. The data collectively indicates a critical need for enhanced fodder production and better management of livestock resources to meet the state's demands (2).

Table-1: Status of fodder and livestock scenario in Manipur

Total livestock population (in thousands of)-Cattle, Buffalo, Mithun, Yak, Sheep and Goat in Manipur								
Cattle	Buffalo	Mithun	Yak	Sheep	Goat			
44.3	219.5	66.4	10.1	0.0	11.5			
Area Under Fodder in Manipur (in hectare)								
Marginal	Small	Medium	Large		Total			
0.04	0.00	0.00	0.00	0.02	0.04	0.00		
Production, Requirement and Excess/Deficit of Milk in Manipur								
Production (000 tonnes)	Requirement (000 tonnes)		Excess (+)/ Deficit (-) (000 tonnes)		Deficit/Surplus (%)			
79	95.27		-16.27		-17.08			
Green fodder availability ('000) deficit/surplus status in Manipur								
Cultivat ed Land	Cultivat ed Wastela nd	Sourc e Fallo w land	Pastur e land	Fores t	Total Green Fodder Availabilit y	Total Green Fodder requireme nt	Percentag e Availabili ty	Percent Deficit (-)/Surpl us (+)
229.8	0.4	0	7	208.2	445.4	759.4	58.6	-41.4

3. Annual Fodder Crops

Annual fodder crops are characterized by a short growth cycle, making them ideal for rotational cultivation to ensure a continuous supply of green fodder, particularly during seasons of scarcity.

3.1. Oat

Oat is a critical Rabi season fodder crop known for its high nutritive value and robust growth. The varieties recommended for Manipur are typically sown between October and November (11).

- **Bundel Jai-2004:** Bundel Jai-2004 is a single-cut Rabi season variety with a sowing time from October to November. It matures in 145-150 days and has a green fodder yield of 40-45

t/ha, a dry matter yield of 9.3 t/ha, and a seed yield of 1.5 t/ha. Its crude protein content ranges from 10-12%. The plant has an erect growth habit with profuse tillering and dark green foliage. The variety is known for its tolerance to various diseases, including root rot, crown rust, leaf blight, and powdery mildew. The spikelets also show a distinctive disarticulation by fracture. (1).

- **Bundel Jai 99-2:** Bundel Jai 99-2 is a single-cut Rabi season fodder variety with a sowing time from October to November. It matures in 140-145 days and provides an average green fodder yield of 50 t/ha, with a dry matter yield of 10.5 t/ha and a seed yield of 1.34 t/ha. The crude protein content is 10.7%. The plants are erect and tall, reaching a height of 110-120 cm, with a dark green foliage. This variety is also noted for its resistance to major diseases and pests. (1).
- **Kent:** Kent is a fodder variety for the Rabi season, with a sowing time between October and November. It matures in 145-150 days and provides a green fodder yield of 50 t/ha. Introduced from the USA, this medium-late, erect variety is characterized by long, droopy leaves. Its average plant height at 50% flowering is 75-80 cm, and it is resistant to rust, blight, and lodging. (1).
- **UPO 94:** is a Rabi season fodder variety with a sowing time between October and November. It matures in 150-155 days and provides a green fodder yield of 40-45 t/ha. This variety is medium-late and has an erect growth habit, reaching a plant height of 75-80 cm at the 50% flowering stage. It is also resistant to rust, blight, and lodging.
- **JHO 99-1:** JHO 99-1 is a Rabi season fodder variety with a sowing time between October and November. It has a maturity period of 150-155 days, providing a green fodder yield of 30 t/ha and a dry matter yield of 7 t/ha. The crude protein content is between 9-10%, and the seed yield is 1.5 t/ha. This variety is known for being moderately to highly resistant to grasshoppers and aphids, and moderately resistant to nematodes. It also possesses good quality attributes, with ADF (Acid Detergent Fiber) at 47%, NDF (Neutral Detergent Fiber) at 63%, and IVDMD (In Vitro Dry Matter Digestibility) at 57.4%. (1).

3.2. Cowpea

Cowpea is a Kharif season legume that improves soil fertility through nitrogen fixation. It is typically sown from May to July (1).

- **UPC-628:** UPC-628 is a Kharif season fodder variety with a sowing time between May and July. It matures in 35-40 days and provides a green fodder yield of 40 t/ha. This variety is tolerant to drought and other edaphic/abiotic stresses. It is also resistant to diseases such as cowpea yellow mosaic virus, anthracnose, and leaf blight. (1).
- **UPC-622:** UPC-622 is a Kharif season variety with a sowing time between May and July. It matures in a short period of 35-40 days and provides a green fodder yield of 32 t/ha. A key feature of this variety is its impressive tolerance to various stresses and diseases, including drought and other edaphic stresses. It is also resistant to several diseases like cowpea Yellow Mosaic Virus, Anthracnose, Root/Collar Rot, and BLB, as well as pests such as aphids, leaf miner, flea beetle/defoliators, pod borer, and root knot nematode. Additionally, it is tolerant to bruchids. (1).
- **Bundel-Lobia-1:** Bundle-Lobia-1 is a Kharif season fodder variety with a sowing time between May and July. It offers a green fodder yield of 30-35 t/ha, a dry matter yield of 4-5 t/ha, and a seed yield of 6.5 q/ha. The crop has a crude protein content ranging from 15.3-16.1% and is notably tolerant to pests such as the semi-looper, beetle, and leaf hopper.

3.3. Fodder Maize

Fodder maize is a fast-growing annual crop, providing high biomass for silage or green fodder.

- **African Tall:** is a fodder variety for the Kharif season, with a sowing time from May to August. It is a very tall plant, reaching up to 9 feet in height, and provides a green fodder

yield of 60 t/ha. Its nutritional profile includes a dry matter content of 17.65% and a crude protein content of 9.80%.

- **J-1006:** is a Kharif season variety with a sowing time from May to August. It is a fast-growing crop, with green fodder ready for harvest in 45-60 days and seeds in 80-90 days after sowing. The green fodder yield ranges from 40-50 t/ha, while the seed yield is 15-20 q/ha.

3.4. Ricebean

Ricebean is a resilient Kharif legume, well-suited to the agro-climatic conditions of Manipur (13).

- **Bidhan-1:** Bidhan-1 is a fodder variety suited for the Kharif season, with a recommended sowing time between May and July. It provides a green fodder yield of 35-40 t/ha and a seed yield of 20 q/ha. The plant has an average height of 130-140 cm, is initially erect but becomes viny later in its growth, and has prolific branching. Its stems are light green, with a leaf-to-stem ratio of 0.75-0.8. The plant produces yellow flowers, and its pods are 7-9 cm long, containing 6-7 bold seeds. A key feature of this variety is its tolerance to drought, cold, and water logging. (1).
- **Bidhan RB-2:** Bidhan RB-2 is a fodder variety for the Kharif season, with a sowing time from May to July. It offers a green fodder yield of 35-40 t/ha and is notable for its resistance to the Yellow Mosaic Virus. The plant reaches a height of 130-140 cm, with an early erect growth habit that becomes viny at later stages, and it features profuse branching. It flowers in 110-120 days and matures in 160-180 days (1).

4. Breeding Methods for Fodder Crop Improvement

Genetic improvement of fodder crops is crucial for developing high-yielding, disease-resistant, and climate-resilient varieties (3). The primary objectives of fodder crop breeding include enhancing biomass yield, improving nutritive value, and imparting resistance to biotic and abiotic stresses (14). Several breeding methods are employed to achieve these goals.

3.1. Selection

It is a fundamental breeding method that involves identifying and propagating plants with desirable traits (3). In fodder crops, both mass selection and progeny selection are commonly used.

- **Mass Selection:** This involves selecting a large number of superior-looking plants from a population and using their seeds to form the next generation (3). It is effective for improving traits with high heritability, such as plant height and leaf-to-stem ratio.
- **Progeny Selection:** This method involves selecting plants based on the performance of their offspring, which provides a more accurate assessment of their genetic potential (3). This is particularly useful for improving complex traits like dry matter yield and crude protein content (15).

3.2. Hybridization

Hybridization, or cross-breeding, is the process of crossing two genetically diverse parents to combine their desirable traits into a new hybrid variety (3).

- **Heterosis Breeding:** This is a key application of hybridization, aimed at exploiting hybrid vigor (3). When two inbred lines are crossed, the resulting F1 hybrid often shows enhanced vigor, yielding significantly more biomass and exhibiting improved resistance compared to its parents (3). The BXN Hybrid varieties (Co-4 and Co-5) are prime examples of successful heterosis breeding in fodder crops (16,17).

3.3. Mutation Breeding

Mutation breeding involves inducing genetic variations through physical or chemical mutagens to create new traits that are not present in the existing germplasm (14, 17). This method is

particularly useful for improving specific traits like pest or disease resistance, or for developing varieties that can tolerate specific environmental stresses (15).

4. Perennial Fodder Crops

Perennial fodder crops offer a sustainable, long-term solution to fodder scarcity due to their ability to provide multiple cuts over several years (11).

4.1. BXN Hybrid:

The BXN Hybrid varieties, a cross between Bajra and Napier grass, are known for their high biomass productivity and rapid regeneration (18).

- **Co-4:** Co-4 is a high-yielding fodder crop with a number of desirable attributes for livestock feed. It provides a substantial green fodder yield of 375-400 t/ha/yr across seven harvests. The crop's nutritional profile includes a dry matter content of approximately 21.3% and a crude protein content of 10.71%, resulting in a crude protein yield of 8.71 t/ha/yr. The oxalate content is at a manageable 2.48%. Key physical characteristics include broader leaves and succulent stems, which contribute to its high green fodder and dry matter yields. The plant also demonstrates notable winter hardiness, providing a stable yield throughout the year, and has a quick regeneration capacity after harvest. (1).
- **Co-5:** Co-5 is another high-yielding fodder variety with a green fodder yield of 360-400 t/ha/yr over seven harvests. This crop has a high dry matter content of 22%, leading to a dry matter yield of 80 t/ha/yr. The crude protein content is an impressive 14%, with a corresponding crude protein yield of 9.6 t/ha. The oxalate content is a low 2.4%. Similar to Co-4, Co-5 features broader leaves and succulent stems, exhibits winter hardiness, provides a stable yield year-round, and has a fast regeneration capacity. (1).

Conclusions

Manipur's livestock sector is a vital part of the state's agriculture, but it faces a severe and chronic fodder deficit, which acts as a major bottleneck to productivity. Despite a total livestock population of 342.3 thousand, the state only produces 58.6% of its required green fodder, resulting in a 41.4% deficit. This is primarily due to the minimal area under fodder cultivation, which is a mere 0.04 hectares. This shortage directly impacts milk production, with a 17.08% deficit against the state's requirements.

The strategic cultivation of both annual and perennial fodder crops is a critical solution to this problem. The text highlights several recommended annual fodder crops like oat, cowpea, fodder maize, and ricebean, which are adapted to different seasons and offer high yields. Perennial crops like the BXN Hybrids (Co-4 and Co-5) are particularly promising because they provide multiple harvests and stable yields throughout the year, even during winter.

To further improve the fodder scenario, the chapter emphasizes the importance of genetic improvement through breeding methods. Selection, hybridization, and mutation breeding are crucial for developing new varieties that are high-yielding, nutritious, and resistant to biotic and abiotic stresses. These breeding efforts are key to ensuring a sustainable and adequate feed supply.

In essence, addressing Manipur's livestock challenges requires a multi-faceted approach: expanding the area under fodder cultivation, promoting the use of recommended high-yielding annual and perennial varieties, and investing in continuous breeding programs to improve crop resilience and nutritional value. Implementing these strategies will not only bridge the existing fodder and milk deficits but also ensure the long-term sustainability and profitability of the state's livestock sector.

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