

REVIEW PAPER

Production of Green Fodder: A Way to Increase Milk Productivity and Strengthen Dairy Farming in India

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ABSTRACT

Livestock and dairy farming are an important occupation of Indian farmers which boost economy of country. India has first rank in milk production worldwide but milk productivity is less due to unavailability of quality fodder round the year. Feeding of animals with any fodders not found suitable for milk productivity, health and profitability of dairy farming. Dairy cattle require nutrients to produce milk, especially during the first 3 to 4 months after calving, when milk production is highest. Green fodder is an economic source of nutrients for the dairy animals. It is highly palatable, digestible and primary source of vitamin A. Micro-organisms present in green fodder help in improving digestibility of crop residues under mixed feeding system. Feeding of green fodder including *Azolla* to milch animals means not only enhance the milk production but also increase the quality of milk by increasing the content of unsaturated fat, Omega 3 fatty acids, vitamins, minerals and carotenoids. It also helps in maintaining good health and improving breeding efficiency of animals. Increased use of green fodder in the ration of animals may reduce cost of milk production. Keeping in view the above facts, this review paper has highlighted forms of green fodder and latest released varieties of fodder crops in India.

HIGHLIGHTS

- ① Green fodder is a cheap and highly nutritious feed responsible for the overall health and breeding efficiency of animals.
- ① Fodder cultivation is directly related to the milk production, birth rate and health of milch animals. So, sustainable development of dairy depends solely on quality green fodder production in required quantity.
- ① Availability of green fodder round the year is essential for the milk productivity of animals.
- ① High yielding varieties of fodder crops may fulfill the needs of increasing demand of it for animals.

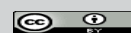
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In India, Livestock and dairy farming play important role in agricultural economy (Singh *et al.* 2021). India has first rank in the world in milk production with a production of 198 million tonnes (Jayalalitha and Thomas, 2023). Animal feed and fodder is one of the main factors affecting milk composition, production and quality of dairy products than the genetic potential of dairy breeds (Ravichandran *et al.* 2020; Bounoua *et al.* 2024). Enhance the efficiency of dairy farming systems, a diet is a major challenge to achieve dairy potential and meet the

needs of a demanding dairy industry (Bir *et al.* 2015). In compare to developed countries, the milk productivity of dairy animals in India is lower. The main reason behind it is acute shortage of green fodder, dry fodder, concentrates, feeding of low quality of roughages, decreasing of pasture lands

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and high price of feed and fodders (Naik *et al.* 2012; Gamit *et al.* 2021). Other current challenges in fodder production are shortage of agriculture land for fodder production, adverse effects of climate changes, marginal or small size of land holdings, more devotion of farmers to grow food crops rather than fodder crops, scarcity of water or irrigation facilities, low or non-availability of cultivable land, lack of labor, non-availability of high yielding varieties of fodder seeds, lack of knowledge about green fodder production (Kumar *et al.* 2018; Ahamed *et al.* 2023; Nagaraj *et al.* 2023). Due to increasing population, demand of milk is increasing worldwide, and it is expected to increase 1077 million tons by 2050 (Ahamed *et al.* 2023). Similarly, the demand of green fodder and dry fodder is expected to reach to 1012 and 631 million tonnes of by the year 2050 respectively (Gupta *et al.* 2019). It is expected that there will be 18.4% deficit in green fodder and 13.2% deficit in dry fodder in the year 2050 Table 1 (Gupta *et al.* 2019).

Green fodder is essential component of animal feed which helps to increase milk productivity due to high nutrients (Kaur *et al.* 2012; Ravichandran *et al.* 2020; Singh *et al.* 2021). Dairy milch animals producing up to 12-15 liters milk per day may be maintained by feeding green fodders. In a research study on milk productivity of livestock by Senthilkumar and Babu (2016) found that after feeding green and dry fodder to milch animals, the indigenous milch animals had gained an average increase of milk yield of 5.46 liters on daily basis while cross breeds produced an average increase milk yield of 2.78 liters on daily basis (Table 2). Similarly, Hossain *et al.* (2017) in an experiment on twenty-

eight buffaloes reported that green fodder based balanced rations was found to be an economical and environmental friendly, as compared to feeding only concentrate and dry roughage based balanced rations in lactating buffaloes.

A floating water fern azolla may be used green fodder. Feeding of Azolla as a green fodder feed supplements for milch animals (500-1000 gm per day) may increase the milk production by 7-13% (Kumar *et al.* 2020). This green fern also have high digestibility by dairy cows due to high protein and low lignin content.

Maximum animals due to unavailability of sufficient quantity of green fodder fight to their health issues, birth capability and milk production (Naik *et al.* 2012; Singh *et al.* 2018). Although, milk gets assured price and year-round demand but, dairy is also facing many problems in now a days. Price for the milk is not going up matching to the price hike for cattle feed and other inputs. Income generated by selling milk is spent entirely for feeding the animal itself which accounts 65-70 per cent expenses on overall expenses (Kumar *et al.* 2012; Gupta *et al.* 2019; Kumar *et al.* 2020). Over-dependence on ready cattle feed has created this situation. Milk production and productivity has come down by ignoring green grass and leguminous fodder. Even today many traditional farmers depend entirely on wheat, pearl millet and paddy straw to feed their dairy animals. This affects both milk productivity and the health of the animal. Moreover, green fodder cultivation decreases the expenses which incurred on purchase of ready-made cattle feed on production of milk and increase the income of

Table 1: The scenario of feed and fodder availability (MT) in India

Sl. No.	Year	Supply		Demand		Deficit as % of actual demand	
		Green	Dry	Green	Dry	Green	Dry
1	2030	687.4	500.0	911.6	568.1	24.59	11.98
2	2040	761.7	524.4	954.8	594.9	20.22	11.86
3	2050	826.0	547.7	1012.7	631.0	18.43	13.20

Table 2: Milk productivity of livestock after feeding of Green and Dry fodder

Details	Indigenous Breeds		Cross Breeds	
	Before Feeding	After Feeding	Bedore Feeding	After Feeding
Daily average milk yield	8.56 liters	14.02 liters	16.82	19.60

Source: Sentil Kumar and Babu (2016).

farmers. So, feeding of green fodder have important role in boost dairy profitability due to rich source of protein, energy, minerals and vitamins.

Classification of fodder crops

Fodder crops can be grouped as follows:

1. Cereal fodder

Cereal fodder crops include Maize, sorghum, pearl millet, and oat which provide energy-rich herbage to livestock. Cereals are grown for their edible starchy seeds known as 'caryopsis'. Cereal fodders have a determinate growth habit and their herbage quality starts deteriorating after flowering. They have wider adaptability and variability (Rathore P. and Dixit S. 2019). Among these, sorghum green fodder which is also popularly known as Chari in India is one of the widely cultivated crops due to its high green fodder yielding capacity, better nutritive value and suitability for ratooning (Iyanar *et al.* 2015). It may provide plenty of feed in midsummer during lean period due to its warm weather tolerance capacity and multi-cut forage type.

2. Legumes fodder crops

Legumes fodder includes guar, berseem, cowpea, Lucerne, sytodanthes, sun hemp and pea. Legumes by and large are indeterminate in growth and maintain quality traits over longer periods. They have high herbage protein and nitrogen fixing ability (Rathore and Dixit 2019). Sun hemp is harvested at vegetative stage to feeding animals because after flowering since it has a negative substance called HCN.

3. Grass fodder

Grass fodder includes Hybrid Napier, guinea grass, Dharaf grass, marvel grass, setaria grass, anjan grass (buffel grass), etc. These are introduced and native grasses for pasture, grazing, and hay and can be either annual or perennial and either single cut or multi-cut.

4. Fodder trees and shrubs

Fodder trees and shrubs includes sesbania, subabul, mulberry, gliricidia, norimga (drumstick), acacia (babul), spineless cactus, rain tree, jackfruit, arecanut, melia and azadirechata (neem). Shoots or

sprouts, tender twigs and stems of woody plants along with their leaves, flowers, fruits or pods are raised to feed livestock (Rathore P. and Dixit S. 2019). They are hardy and provide year-round fodder for use during lean periods. Their leaves are high in protein, with 10-30% of Dry Matter (DM) and can replace concentrates. However, while the availability of tree leaves is seasonal, concentrates are available all year round. In dry periods, trees and shrubs remain green longer than grasses because of their deep root system which can tap water. When grasses are scarce, fodder trees stay green and provide the required energy and protein. Some fodder tree species improve soil fertility by providing green mulch or by fixing atmospheric nitrogen and even provide construction material, firewood, shelter, shade or edible pods.

5. Other crops

Root crops such as turnip, carrot and fodder beet, *Brassica* spp., and vetches are supplementary sources of feed. Due to early bulking capacity and short duration, they are often grown as catch crops.

Fodder crops can also be classified based on their nature and growth. Annuals such as maize and cowpea complete their life-cycle in one season while perennials such as Guinea grass and Lucerne provide fodder for more than one season or year. Their classification based on family, splits them into leguminous (guar, berseem, cowpea, lucerne) and non-leguminous crops (maize, pearl millet, sorghum, and oat). There are also rainfed fodder crops (fodder pearl millet, *Stylosanthes*) and irrigated fodder crops such as Hybrid Napier, guinea grass, Lucerne, etc. Range species/grasses comprise of Dharaf grass, marvel grass, setaria grass, anjan grass, etc. (Rathore P. and Dixit S. 2019).

Strategies to increase green fodder production

India has the largest livestock populations in the world. The green fodder source of livestock is fodder crops, grasses, weeds and tree leaves gathered from cultivated and uncultivated lands and grazing on common lands and harvested fields (Dixit and Birthal, 2010). To overcome the gap between demand and supply of green fodder, there is a need to improve green fodder the yield through use of improved varieties of fodder seeds. For ensuring round year green fodder production,



farmers need to purchase seed / planting material of improved high yielding varieties of fodder crops through authentic source, fodder crops should be shown according to recommended package and practices during cultivation of fodder crops, need to crop rotation (In one season fodder cereals and in another season fodder legumes), intercropping (cultivate cereal fodder crops like maize, bajra and sorghum along with fodder legumes like cowpea, cluster bean and velvet bean, plantation of fodder trees and shrubs on path or boundaries of farms, need to adopt agri-fodder tree systems like cultivation of maize sorghum crops along with ziziphus species, jack fruit, areca nut tree etc., growing of perennial grasses like dhaman grass, sewan grass, anjan grass, rhodes grass and fodder trees like *prosopis cineria*, desi babool, neem, shisam, kanchan, aaradu, subabul and *Gliricidia* on fallow lands/wastelands/community for grazing in rainfed and arid areas, Growing short duration varieties of fodder crops such as carrot, cabbage, cauliflower, turnip, cowpea, guar, cucurbits etc. between two main seasonal crops, sowing of high yielding multi-cut perennial fodder crop like Hybrid Napier grass in fields and also on boundaries of other crop fields, need to cultivate the multi-cut fodder crops

at regular intervals (30 to 45 days) 10 cm height from ground level to get optimum production and quality fodder.

Varieties of fodder crops in India

Scarcity of green fodder and poor nutritional quality affect the livestock health, milk productivity and dairy economy. High green fodder yielding cultivars of crops are backbone of continuous green fodder production for healthy dairy farming and milk productivity. There are some important major fodder crops which have high fodder yield potential as well as rich in nutritional components. These major crops and their high green fodder yielding cultivars are essential to fulfill the scarcity of green fodder in dairy farming (Roy *et al.* 2020). In the past, the green fodder production was limited due to unavailability of fodder varieties with high fodder yield and grain quality. The productivity and nutritive value of forage crops may be enhanced by providing to farmers the green fodder varieties including multi-cut with high fodder yield potential and rich nutritive quality. The major fodder crops and their varieties (Roy *et al.* 2020) are briefly explained in Table 3.

Table 3: List of some high fodder yielding released varieties of some major fodder crops

Sl. No.	Name of crop	Season	Variety	Nature of variety	Green Fodder Yield (Q./ha.)
1	Sorghum	Kharif	CO (FS)-29	Multi cut variety	1720.0 q/ha (in 5 cuts / year)
			CSH-13-R Hybrid	Single cut dual purpose type	255.0 q/ha
			CSH-20 MF (UPMCH - 1101)	Multi cut variety	870.2 q/ha
			Haryana Jowar – 513 (S-513)	Variety dual purpose type	450.0 q/ha
			GAFS 11	Multi cut variety	400-450 q/ha
2	Pearl millet	Kharif	Anand Forage Bajra-3	Single cut	450-460 q/ ha
			NDFB-5/Narendra Chara Bajra-5	Double cut / dual purpose	505.10q
			APFB 09-1	Multi cut variety	302.0 q/ha
			Moti Bajra	Multi cut variety	811 q/ha in 3 cuts;
			TSFB 15-4	Single cut variety	426 q/ha
3	Maize	Kharif	TSFM 15-5	Open pollinated variety	445 q/ha
			Pratap Makka Chari-6 (EC-3135)	Composite variety	405.0 q/ha
			African Tall	Composite variety	595.0 q/ha
			APFM-8	Synthetic variety	554.0 q/ha
4	Cowpea	Kharif	IL 1177	Self pollinated, high biomass	252.4q/ha
			UPC-607	Annual dual purpose type	350.0 q/ha
			TNFC-0926	Multi cut variety	252.9 q/ha
			CO 9 (TNFC 0924)	Variety	247.6 q/ha



5	Cluster bean / Guar	Kharif	Guar Kranti (RGC-1031)	Variety dual purpose type	340.0 q/ha
			Bundel Guar-3 (IGFRI 1019-1)	Variety dual purpose type Dual purpose type	345 q/ha
6	Oat	Rabi	Bundel Jai-2001-3 (JHO-2001-3)	Variety single cut	515.0 q/ha
			Jawahar Oat 03-93	Variety Sincel cut	460.0 q/ha
			JO-1	A multi cut forage variety	540.0 q/ha (in 2 cut)
			Narendra Jayee-1 (NDO-1)	Single cut variety	480-510q
			NDO-1101/Narendra Jayee-1101	Single cut variety	500 q /ha
			OS 403	Fodder Variety	454 q/ha
7	Berseem/ Egyptian clover	Rabi	BL-180	Multi cut variety	625.0 q/ha
			Hisar Berseem-1 (HFB-600)	Multi cut variety	735.0 q/ha
			HB-2	Semi-erect, vigorous	785q/ha
			JB-5	Multi cut forage variety	580.0 q/ha
			JB 05-9	Multi cut forage variety	650-680 q/ha
			BL 43 (PC 75)	Multi cut variety	550-580 q/ha
8	Lucerne/Alfalfa	Rabi	Anand Lucerne-4 (AL-4)	Variety, Perennial nature	400-500 q/ha
			CO-2	Variety	1300 q/ha
			Krishna (RRB-07-1)	Perennial composite variety	1803.70 q/ha in perennial condition
			TNLC-14	Multi cut variety	505.3 q/ha/yr
9	Lathyrus	Rabi	Alamdard 51	Herbaceous Perennial variety	559-594 q/ha
			Madhuri	Annual	187q/ha
10	Barley	Rabi	RD-2715	Variety dual purpose	180.0 q/ha
			VL Barley-1	Variety dual purpose	200.0 q/ha

Source: Database of Forage Crop Varieties: 2020. AICRP on Forage Crops & Utilization, ICAR-IGFRI, Jhansi. pp 362).

CONCLUSION

To provide farmers with quality seed of high green yielding varieties can increase more efficiency of Indian farmers for fulfill the demand of green fodder. Feeding of green fodder increased productivity of milch cattle that can promote the farmers to boost dairy farming as an enterprise.

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