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Good Agricultural Practices of Forage Crops: A Comprehensive Guide

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Out of total Indian geographical area of about 328 million hectares, only 161.3 million hectares (roughly 52.7 percent) is arable. In today's interconnected world, the dissemination of forage technologies holds the potential to transform traditional farming practices into modern, sustainable systems. Livestock husbandry is an important sector of our economy and a major component of the National Food Security system. Livestock production is the backbone of Indian agriculture and a source of employment and ultimate livelihood for 70% of the population in rural areas. Shift in the lifestyle of people in feeding habits towards milk products, meat and eggs resulted increase in the demand for livestock products. By embracing innovation and best practices, farmers can navigate challenges, capitalize on opportunities, and contribute to building resilient and thriving agricultural systems for generations to come.

Choice of suitable forage crops and their varieties:

Fodder crops are the plant species that are cultivated and harvested for feeding the animals in the form of forage (cut green and fed fresh), silage (preserved under anaerobic condition) and hay (dehydrated green fodder).

Leguminous fodders: The leguminous fodders have special significance because of high herbage protein and partial independence from soil for their nitrogen needs.

Non-leguminous fodders: Non-leguminous fodders provide energy-rich herbage to livestock.

Crop and its variety should be selected according to soil type, area and situation.

i. *For irrigated and arable land conditions:* Bajra × Napier hybrids, guinea grass, rye grass, setaria, maize, sorghum, oat, cowpea, berseem, lucerne, etc.

ii. *For rainfed and non-arable land:* Perennial grasses like Tall fescue, Orchard grass, *Brachiaria* spp., *Paspalam* spp., *Chrysopogon* spp., *Bothriocloa* spp., *Setaria* spp., Guinea grass, etc and Perennial legumes like red clover, white clover and *Stylosanthes etc.*

Cropping systems

Cropping systems should be selected in such a way that it should also help in stability and sustainability of soil fertility in long run, minimize harbouring of insect-pest and diseases. Potential intensive cropping system according to agro-climatic zones are as under;

i. North Zone

1. Maize + Cowpea – Sorghum + Cowpea 2cuts) – Berseem + Mustard.

2. Sudan grass + Cowpea – Maize + Cowpea – Turnip – Oats (two cuts).

3. Hybrid Napier or Setaria inter-planted with cowpea in summer and Berseem in winter (9 -10 cuts/year).

4. Teosinte + Cowpea (two cuts) – Carrot – Oats + Mustard/Senji (two cuts).

ii. Western and Central Zone

1. Bajra + Guar (Clusterbean) (2 cuts) – Annual Lucerne (6 cuts).

2. MP Chari + Cowpea (2 cuts) – Maize + Cowpea - Teosinte + Cowpea (2 cuts).

3. Hybrid Napier or Guinea or Setaria grass interplanted with Cowpea in summer + Berseem in winter (8-9 cuts/year).

4. Hybrid Napier or Guinea or Setaria grass interplanted with Lucerne (8-9 cuts/ year).

iii. Southern zone

1. Sorghum + Cowpea (3 cuts) – Maize + Cowpea – Maize + Cowpea

2. Hybrid Napier or Guinea or Setaria grass interplanted with Lucerne (8-9 cuts/year)

3. Hybrid Napier + Subabul / Sesbania (9-11 cuts/year).

4. Sudan grass + Cowpea (3 cuts) – Sorghum+ Cowpea (3 cuts).

5. Para grass + Centro (Centrosema pubescens) (9-11 cuts/year).

iv. Eastern zone

1. Maize + Cowpea – Teosinte + Rice bean (2 cuts) – Berseem + Mustard (3 cuts).

2. M.P. Chari + Cowpea – Dinanath grass (2 cuts) – Berseem + Mustard (3 cuts).

3. Para grass + Centrosema pubescens (8-9 cuts/year).

4. Hybrid Napier or Setaria grass inter-planted with Subabul or Common Sesban (Sesbania sesban) (9-10 cuts/year).

The important high yielding cultivated forage crop varieties under different situations are enlisted as under;

Crop and Variety	Areas of adaptation	Green forage (q/ha)
I Cultivated Fodder Cereals		
Sorghum (*Sorghum bicolor* (L) Moench)		
Pusa Chari-6 & 9	Whole of India	400-450
HC-136	Whole of India	400-500
M.P. Chari	North India	400-500
Meethi Sudan (SSG-59-3)	Whole of India (Multicut)	500-550
Jawahar Chari-6	M.P.	350-450
Jawahar Chari-69	M.P. (Multicut)	350-450
HC-308	Whole India	350-550
PCH 106	Whole India	650-900
Pantchari 3 (UPFS-23)	U.P.	350-450
MFSH-3	Whole India	500-850
Bajra (*Pennisetum glaucum* (L) Leek.)		
Giant Bajra	Entire bajra growing tract	350-400
K-677	Entire bajra growing tract	400-500
Raj Bajra Chari-2	Entire Bjara growing tract	300-450
L-72	Entire bajra growing tract	400-550
Fooder cumbu-8 (TNSC-1)	Entire Bajra growing tract	270-400
Maize (*Zea mays* L.)		
African tall	Whole of India	500-600
Vijay composite	Whole of India	350-450
Jawahar	Whole of India	350-450
Moti composite	Whole of India	350-425
Manjari Composite	Whole of India	400-450
Oats (*Avena sativa* L.)		
Kent	Whole of India	450-500
OS-6	Whole of India	400-500
UPO-212	Whole of India	370-520
OL-125	Whole of India	350-480
UPO-94	Whole of India (Multicut)	450-500
JHO-822	Central India	450-550
JHO-851 (Multicut)	Whole of India	500-550
II Cultivated Fodder Legumes		
Cowpea (*Vigna Unguiculata* (L) Walp.)		
NP-3 (EC-4216)	Northern, Western and Central India	300-350
UPC-287	Whole of India	350-400
UPC-5286	Whole of India	350-450
UPC 8705	Whole of India	300-420
C-30	Whole of India	300-350
Shweta (No.998)	Whole of India	300-350
Bundel Lobia 1 (IFC-8401)	Whole of India	250-300

Guar (*Cyamopsis tetragonoloba* (L) Taub.)

HFG 156	Guar growing area of India	200-250
FS-277	Guar growing area of India	175-250
Bundel Guar-1(IGFRI 212-1)	Guar growing area of India	220-350
Bundel Guar-2 (IGFRI 2395-2)	Guar growing area of India	280-400
HFG-119	Guar growing area of India	250-300

Berseem (*Trifolium alexandrinum* L)

Mescavi	Northern and Central India	800-900
Wardan (S-99-1)	All India	900-1500
JB-2	Northern and Central India	900-1000
BB 2 (JHB 146)	North West and Central zone	580-850
BL-2	Northern India	650-900
UPB-103	Northern, Central and part of South India	1000-1150

Lucerne (*Medicago sativa* L)

Type-9	Whole of India	900-1000
Anand-2	Gujrat, Rajasthan, Haryana, M.P. & U.P.	850-900
RL 88	Whole of India	700-1000
SS-627	Haryana, Punjab, Delhi, U.P., Rajasthan, H.P. & M.P.	800-950

III Cultivated fodder -perennial grasses

Napier-Bajra hybrid (*Pennisetum purpureum* x *P. glaucum*)

Pusa Giant	Whole of India and tropics	1000-1300
Swetika-1 (IGFRI-3)	U.P., M.P., NE hills, Punjab & hills of North India	1100-1200
IGFRI-6	U.P., H.P., NE hills, Punjab and hills of North India (intercropping)	1200-1300
Yeshwant (RBN-9)	Whole of India	1300-1400

Guinea grass (*Panicum maximum*) Jacq.

PGG-1	North-West states	900-1100
PGG-3	Northern, North-West and Central India	800-1000
PGG-9	Northern, North-West and Central India	900-1100

Table 1: Package of practices of important forage crops

Crop	Sowing time	Seed rate (kg/ha)	Spacing and depth
Sorghum	March-July	25-35	30x10 cm, 3 cm
Maize	April - July	40-50	30x15 cm, 3-4 cm
Pearlmillet	March-July	12-15	25x10 cm, 2 cm
Cowpea	March-July	20-25	30x 10 cm, 3 cm
Cluster bean	April - July	25-40	30-45 cm R to R
Berseem	October	25	25 cm R to R or broadcasting
Lucerne	Mid of October	12-15	25 cm R to R, 2 cm
Lathyrus	October to November	50	30-35 cm R to R , 4 cm
Oat	Mid October to last November	80-100	20-25 cm cm R to R for low tillering & 25-30 cm R to R for high tillering varieties, 4 cm depth
Barley	October to November	80-100	20-25 cm R to R, 4 cm
Berseem	October	25	25 cm R to R or broadcasting
Lucerne	Mid of October	12-15	25 cm R to R, 2 cm
Lathyrus	October to November	50	30-35 cm R to R , 4 cm
NB Hybrid	March to August	20000 to 35000 rooted slips	100x50 to 75x50 cm
Guinea grass	March to August	20000 to 40000 rooted slips	100x50 to 50x50 cm

Table 2: Nutritional composition of different crops

Crop	FYM (t/ha)	Nitrogen (kg/ha)	Phosphorus (kg/ha)	Potassium (kg/ha)	N top dressing (kg/ha)
Sorghum (S)	25	30	40	20	30 kg N/ha 30 DAS
Sorghum (M)	25	30	40	20	30 kg N/ha 30 DAS, 30 kg N/ha just after cutting
Maize	25	30	40	20	30 kg N/ha 30 DAS
Pearlmillet	25	25	20	12.5	25 kg N/ha 30 DAS
Cowpea	25	25	40	20	-
Cluster bean		15	90	20	
Berseem	-	20	80-90	30-40	-
Lucerne	-	20	60-75	40	-
Lathyrus	-	20	40	-	-
Oat (one cut)	15	60	40	-	20 kg N after Ist irrigation
Oat (two cut)	15	80	40	-	40 kg N after Ist cut
Oat (multi cut)	15	100-120	40	40	40 kg N after each cut
Barley	-	45	30	20	15 kg N after Ist irrigation
NB Hybrid	15-25	40	50	50	30 kg N after each cut
Guinea grass	15-25	50	50	50	30 kg N after each cut

Table 3: Irrigation schedule for different crops

Crop	Irrigation No./ scheduling
Maize	It requires 5-6 irrigations at 10-12 days interval during summer season and 1-2 during rainy season. In excess rainfall areas, proper drainage facility should be assured.
Sorghum	Rainy season (July) sown crop may also require 2 irrigations depending upon distribution of rains. For summer sown crop, 5-6 irrigations are required due to high ET demand.
BN hybrid	The crop should be planted in well moist soil condition. During monsoon seasons, the irrigation is rarely needed in event of long monsoon failure. The crop needs regular irrigation at an interval of 15-18 days in March to May, at 10-12 days interval in summer months
Berseem	October to February: 14-16 days interval (Clay and clay loam soil), 12-14 days interval (Loamy soil) October to February: 10-12 days interval (Clay and clay loan soil), 8-10 days interval (Loamy soil)
Lucerne	15-20/ At early stage:7-10 days interval. Later on: 25-30 days interval During summer: 15-20 days interval.
Oat	First: 20-25 DAS, 4-5 (Single cut) & 7-8 (Double cut)

Table 4: Herbicide based weed management strategies for fodder crops

Crop	Strategies
Cowpea	Pre-plant incorporation of Trifluralin (0.75 kg with 600 litre of water/ha) herbicide.
Guar	Pre-plant incorporation of Nitralin (0.75 kg /ha) herbicide.
Berseem	1. Dipping the seed in 5-10% solution of table salt for five minutes, light weight weed seeds float while heavy weight forage seeds will settle down at the bottom. 2. Use stale seed bed technique: Pre-sown irrigation followed by spraying of paraquat herb-icide for newly germinated weeds. 3. Pre-plant incorporation of EPTC (1.5 kg /ha) herbicide. 4. Pre-emergence application of Butachlor (2.0 kg/ha), Pendimethalin (0.75 kg/ha)

	5. Post emergence (3-4 trifoliate leaf stage) application of MCPB (0.50 kg/ha) herbicide for control of broad leaf weeds. 6. Note: EPTC should not be used in fields where a trizine herbicide was applied in the previous season
Lucerne	7. Dipping the seed in 5-10% solution of table salt for five minutes, light weight weed seeds float while heavy weight forage seeds will settle down at the bottom. 8. Use stale seed bed technique: Pre-sown irrigation followed by spraying of paraquat herbicide for newly germinated weeds. 9. Pre-plant incorporation of Fluchloralin (1.0 kg/ha), benefin (0.75-1.5 kg/ha herbicide. 10. Pre-emergence application of Pendimethalin (0.5-1.0 kg/ha) and oxadiozon (0.5 kg/ha) herbicide. 11. Post emergence (3-4 trifoliate leaf stage) application of 2, 4-DB (0.50-0.75 kg/ha) herbicide for control of broad leaf weeds. 12. Note:
Sorghum	13. Broadcast/ cross sowing of cowpea (25 kg/ha) 14. Pre-emergence and post emergence (at initial growth of forage) application of Atrazine (0.50-0.75 kg/ha), pre-emergence application of Pendimethalin (1.0 kg/ha).
Maize	15. Intercropping with cowpea (25 kg/ha) 16. Pre-emergence application of Atrazine (0.75 kg/ha), Pendimethalin (1.0 kg/ha) with 600 litre of water after sowing on same day or positively by next day before the emergence of seedlings of the crop.
Pearlmillet	17. Pre-emergence application of Atrazine (0.50 kg/ha) with 600 litre of water after sowing on same day or positively by next day before the emergence of seedlings of the crop.
Oat	18. Pre-emergence application of Linuran (0.5 kg/ha) 19. Post-emengence application of 2,4- D sodium salt (0.75 kg/ha)

Table 5: Harvesting schedule of different fodder crops

Crop	Stage of harvest	Time of harvesting
Sorghum (Single cut)	After flowering and up to milking stage	75-80 days after sowing *Note:* To overcome the possibility of HCN poisoning, the crop should be properly irrigated during summer and harvested only after 40-45 days of growth.
Sorghum (Multi cut)	-	2 months after sowing and subsequent cuts 35-40 days after the previous cut *Note:* To overcome the possibility of HCN poisoning, the crop should be properly irrigated during summer and harvested only after 40-45 days of growth.
Maize	Cob formation to milk stage	60-70 days after sowing
Bajra (Single cut)	Boot leaf stage to early flowering	60-75 days after sowing
Bajra (Multi cut)	-	Ist cut 55-60 days after sowing and subsequent cuts 35-40 days after the previous cut
Cowpea	At 50 % flowering	50-60 days after sowing As mixed crop at the time of companion crop
Guar	-	55 days after sowing
Berseem	-	1st cut: 50 – 55 days after sowing & subsequent 25-30 days (5-6 cuts)
Lucerne	-	1st cut: 65-80 days after sowing & subsequent 25-30 days (7-8 cuts)
Lathyrus	50 % flowering	65-70 days after sowing
Oat (single cut)	50 % flowering stage	60 days after sowing

Oat(multi cut)	-	Double cut 1st : 60 DAS & II cut at 50 % flowering Multi cut 1st : 60 DAS, II cut 45 days and III cut at 50 % flowering
Berseem	-	1st cut: 50 – 55 days after sowing & subsequent 25-30 days (5-6 cuts)
NB hybrid and Guinea grass	-	Ist 75 days after planting, subsequent at 30 days interval

Conclusion

The adoption of Good Agricultural Practices (GAPs) in forage crop cultivation is imperative for sustainable and profitable farming. It is crucial for stakeholders, including farmers, researchers, policymakers, and extension agents, to collaborate and disseminate knowledge on GAPs widely. Training programs, extension services, and information-sharing platforms play a vital role in empowering farmers with the necessary skills and knowledge to implement GAPs effectively. There is strong need of a comprehensive policy and planning that advocates for an increased area under fodder cultivation, considering the substantial livestock population in the country. It should also touch upon the choice of suitable forage crops, emphasizing their selection based on soil type, area, and situation.

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