FORAGE RESEARCH IN RAJASTHAN

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Abstract

Rajasthan is the largest state of India and covers nearly 10.4 per cent (342.65 lakh ha) of total geographical area of the country. According to livestock census-2007, Rajasthan ranks at the third place in the country for total livestock population. The large livestock population of the state shows importance of fodder in the state. Under AICRP on Forage Crops and Utilization, many improved varieties of fodder crops and techniques of improved fodder production have been recommended for cultivation to farmers. Important green fodder crops of this region are, viz. peal millet, cowpea, cluster bean and sorghum in Kharif season and oats, lucerne and barley (dual purpose) during Rabi season. Three perennial fodder grasses, viz. *Lasiurus sindicus*, *Cenchrus ciliaris* and *Cenchrus setigerus* are important in the region. Guinea grass and bajra x napier hybrid can also be cultivated where sufficient water is available throughout the year from canal irrigation or tube wells. New varieties developed from Bikaner centre are, viz. Raj Bajra-1 of pearl millet, Krishna of lucerne, Bikaneri Dhaman of *Cenchrus ciliaris* and Jaisalmeri Sewan of *Lasiurus sindicus*. Breeder seed production of pearl millet and oat was done in the past as per the indent received.

Introduction

Rajasthan is the largest state of India and covers nearly 10.4 per cent (342.65 lakh ha) of total geographical area of the country. About 65 per cent of its population is dependent on agriculture. According to livestock census-2007, Rajasthan ranks at the third place in the country for total livestock population (56.663 million) after Uttar Pradesh (60.272 million) and Andhra Pradesh (60.175 million). The large livestock population of the state shows importance of fodder in the state. Rajasthan state has 10 agro-climatic zones and agriculture is mainly rainfed (Figure 1). Out of total geographical area of 342.65 lakh ha, 26.75 lakh ha is under forests, 42.62 lakh ha is not available for cultivation and 63.19 lakh ha is other uncultivable land (excluding fallow land). The total cultivable area is around 220.00 lakh ha. According to State Agriculture Policy (2013), the state has about 17.07 lakh ha of land under permanent pastures for grazing and this area under pasture is not able to meet total fodder requirement of present livestock population. So, fodder security for this increasing livestock population will be ensured by promoting fodder crops and fodder and feed storage systems. Silvipastoral practice will be promoted in the arid western Rajasthan.

Forage crops and grasses are important in arid region of Rajasthan state of India because most of the area is rainfed. Main occupation of the farmers in the area is animal husbandry. Important green fodder crops of this region are, viz. peal millet, cowpea, cluster bean and sorghum in Kharif season and oats, lucerne and barley (dual purpose) during Rabi

season. Three perennial fodder grasses, viz. *Lasiurus sindicus*, *Cenchrus ciliaris* and *Cenchrus setigerus* are important in the region. Guinea grass and bajra x napier hybrid can also be cultivated where sufficient water is available throughout the year from canal irrigation or tube wells. Priority for forage crops and grasses of the region is as follows:

Table 1: Priority crops of the region

Region	Priority I	Priority II	Priority III
Arid*	*Lasiurus sindicus*, moth, pearl millet	Guar	Other range grasses and legumes
Semi-arid**	*Cenchrus ciliaris,Cenchrus setigerus, Panicum antidotale*, pearl millet, sorghum, guar, lucerne	*Dihcanthium annulatum*, maize, NB hybrid**, o**at, cowpea	Other forage crops like barley, etc.
Canal irrigated areas in arid and semi arid areas	Lucerne, maize	Berseem, guinea grass, NB hybrid	

* In arid areas, *Prosopis cineraria* and *Z. nummularia* to be incorporated in the system.

** *Ailanthus excelsa* to be integrated as tree component.

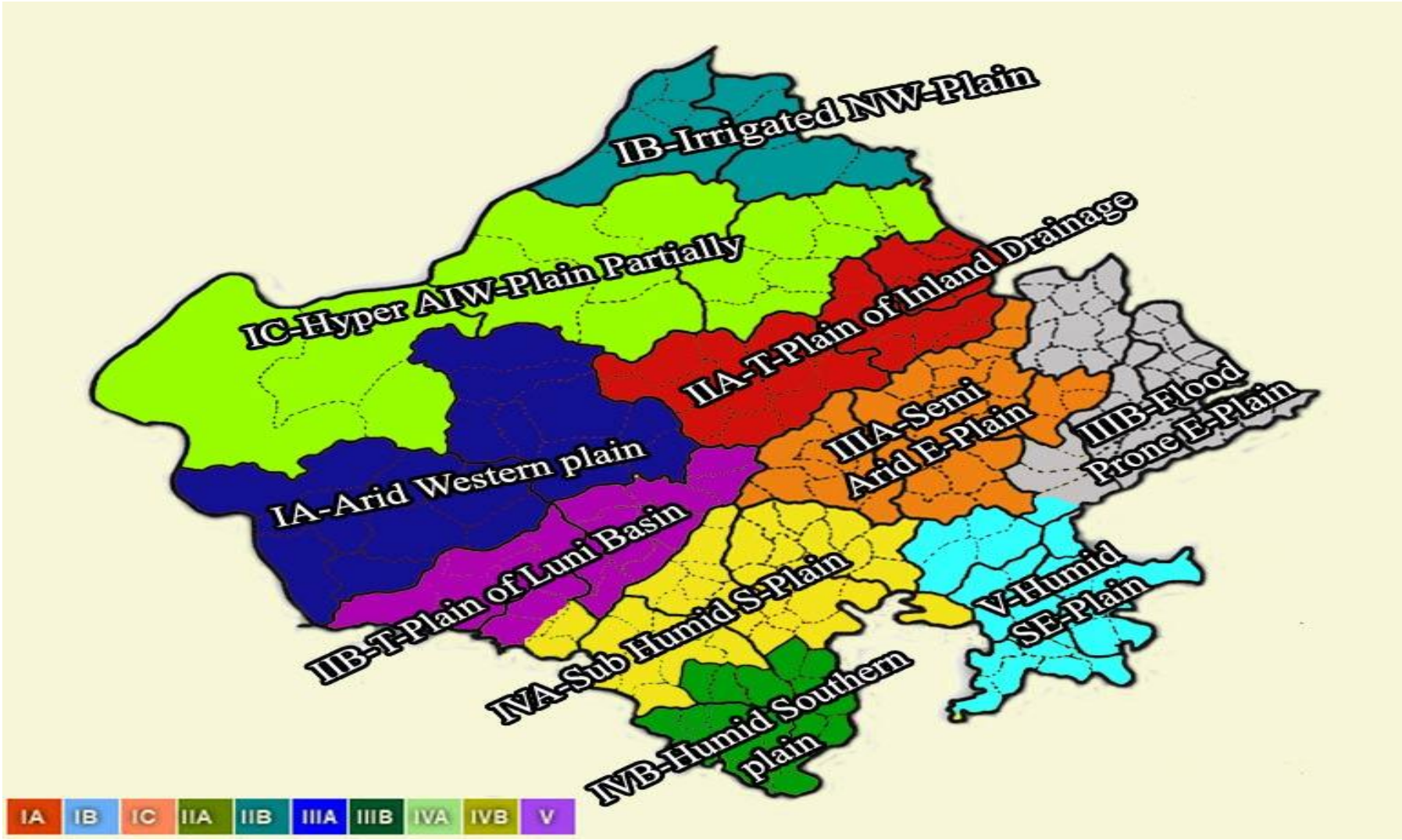

Fig. 1 Map of Rajasthan state showing different zones.

Table 2 : Crop wise area of Rajasrhan state (2011-12) (hectare)

S. No.	District	Guar		Other fodder crops								Total fodder crops
		Seed	Other	Fodder jowar	Fodder bajra	Fodder maize	Fodder gajar	Rajaca	Barseeem	Nepiar grass	Others	
1	Ajmer	5347	1298	121	29	0	9	3120	0	0	1869	11793
2	Alwar	19084	170	9037	59	0	21	123	0	0	1242	29736
3	Banswara	522	107	425	70	0	0	769	21	0	3	1917
4	Baran	0	33	1407	0	1	0	273	3	0	0	1717
5	Barmer	428031	0	134	1176	9	0	371	0	0	7	429728
6	Bharatpur	2175	0	22149	3	0	90	1265	603	0	0	26285
7	Bhilwara	6238	622	16674	1	3	0	2102	0	0	4455	30095
8	Bikaner	901354	0	3242	6	0	8	256	0	0	3180	908046
9	Bundi	345	36	10811	0	0	0	809	1159	0	0	13160
10	Chhittorgarh	3436	9	11254	148	14	0	4248	761	0	807	20677
11	Churu	326758	0	49	219	0	0	5	0	0	2	327033
12	Dausa	5187	21	4425	74	2	72	576	0	0	417	10774
13	Dholpur	403	0	1645	16	0	48	832	0	0	0	2944
14	Dungarpur	2240	0	308	167	24	0	378	0	0	1474	4591
15	Ganganagar	162385	0	17831	0	0	28	0	16551	0	19067	215862
16	Hanumangarh	295571	0	9032	0	0	26	0	9226	0	0	313855
17	Jaipur	38430	0	2624	5202	106	394	0	0	0	6501	53257
18	Jaisalmer	429305	7	27	130	0	2	3	0	0	33	429507
19	Jalore	43170	56	1389	2595	669	2	1668	0	0	51	49600
20	Jhalawar	0	0	1786	8	53	0	1194	55	0	9	3105
21	Jhunjhunu	62340	0	196	3456	0	0	66	0	0	338	66396
22	Jodhpur	141835	178	9972	1093	0	2107	2329	0	0	0	157514

23	Karoli	1118	0	2110	21	5	0	192	0	0	14	3460
24	Kota	0	60	3036	0	13	0	808	30	0	0	3947
25	Nagaur	87082	0	886	1214	0	6	1497	0	0	81	90766
26	Pali	30383	188	1758	268	102	5	2456	0	0	66	35226
27	Pratapgarh	50	1	808	148	28	0	587	85	0	0	1707
28	Rajsamand	2753	479	1905	174	0	2	2398	0	0	280	7991
29	S.madhopur	940	0	2392	17	0	51	521	0	0	122	4043
30	Sikar	77815	0	87	1081	0	102	1020	0	0	18	80123
31	Sirohi	8317	1503	4773	911	400	0	1592	3	39	8	17546
32	Tonk	2696	12	6772	13	4	101	2585	0	0	508	12691
33	Udaipur	10559	852	7859	247	62	0	1361	2	0	130	21072
	Raj. State	3095869	5632	156924	18546	1495	3074	35404	28499	39	40682	3386164

(Source: Agricultural Statistics, 2011-12, Directorate of Economics and Statistics, Rajasthan)

Table 3: Land utilization in Rajasthan (2011-12)

S. No.	Category	Area in hectare	%
1	Total area for land use	34267252	100
2	Forest	2746686	8.02
3	Permanent pastures and other grazing lands	1693790	4.94

(Source: Agricultural Statistics, 2011-12, Directorate of Economics and Statistics, Rajasthan)

Table 3 shows that 4.94% of total area of the state is under permanent pastures and other grazing lands, which also provide fodder to the animals.

Forage Crop Improvement

Breeding objectives

1. Identification and generation of breeding material of range grasses (*Lasiurus sindicus*, *Cenchrus ciliaris, Cenchrus setigerus*, etc.), pearl millet and lucerne.

2. Identification of high yielding strains of fodder crops.

Varietal Improvement

Crop/ Grass	Variety	Year of release	Green fodder yield potential (approx. q/ha)	Area for which recommended
Pearl millet	Raj Bajra-1	2015	500	Whole Rajasthan
Cenchrus ciliaris	Bikaneri Dhaman	2015	200	Whole Rajasthan
Lucerne	Krishna	2016	300 (annual) 800 (Perennial)	North West India
Lasiurus sindicus	Jaisalmeri Sewan	2016	200	North West India

Variety RBB-1 (Raj Bajra-1) of pearl millet and RCCB-2 (Bikaneri Dhaman) of *Cenchrus ciliaris* developed at Bikaner centre have been released at state level in Rajasthan in 2015. RRB-07-1 (Krishna) variety of lucerne developed at Bikaner centre has been released for release for North West zone of the country in 2016. RLSB-11-50 (Jaisalmeri Sewan) variety of *Lasiurus sindicus* grass has been released for North West zone of the country in 2016. Inluding these four varieties, developed at Bikaner centre, the following other varieties of forage crops and grasses are recommended for cultivation on the basis of superior performance observed in varietal trials conducted at Agricultural Research Station, Bikaner and/or their suitability:

1. **Pearl millet:** Raj Bajra-1, Giant Bajra, RBC-2
2. **Sorghum:** Raj Chari-1, Raj Chari-2 for single cutting

   SSG-59-3 for more than one cutting

3. **Cowpea**: Bundel lobia -1, Bundel lobia -2, UPC-5286
4. **Cluster bean**: Bundel guar – 1, Bundel guar – 3
5. **Oat:** Kent, OS-6
6. **Lucerne:**Krishna, RL-88, Anand-2
7. **Berseem:** Mescavi, Wardan
8. **Barley (Dual purpose**): RD-2552, RD-2035, RD-2715
9. ***Cenchrus ciliaris*:** Bikaneri Dhaman, CAZRI-75
10. **Sewan grass:** Jaisalmeri Sewan

With cultivation of the forage crops, grasses and legumes, growing of their improved varieties with their quality seed is important like other cultivated crops to get their more

production and good quality. Genetic improvement work for forage crops and grasses for arid region of Rajasthan is being done at Agricultural Research Station, SKRAU, Bikaner under AICRP on Forage Crops. Main challenge in range grasses to develop improved varieties is presence of apomixis. Due to presence of apomixis, new variability through crosses is difficult to be created. Genetic improvement in the forage crops and grasses is mainly being done for higher fodder productivity with better quality but, in future, work on other aspects like climate change will also be required. For developing varieties under changed climate conditions, screening of the genotypes under different dates of sowing will be required to know their suitability under different temperature conditions.

Germplasm

At this time, Bikaner centre has mandate for breeding work related to range grasses. So, germplasm of important range grasses is being maintained and evaluated at Bikaner centre.

IC Nos. from NBPGR: IC Nos. were obtained for 35 *Cenchrus ciliaris* germplasm entries from NBPGR, New Delhi. The numbers are IC-551555 to IC-551589.

Forage Production Technologies

The following improved fodder production technology have been recommended for farmers based on the agronomy experiments conducted under AICRP on Forage Crops:

- Dual purpose barley gave significantly higher green fodder and grain yield with application of nitrogen as 2/3 basal + 1/3 immediate after first cut under canal irrigated condition. While nitrogen when applied 1/2 basal +1/4 immediate after first cut 1/4 after next irrigation (tillering after cut) recorded significantly higher green fodder yield and grain yield with sprinkler irrigation system under light soil of western Rajasthan .
- Application of 25 % nitrogen through FYM and 50 % NPK through inorganic fertilizers + biofertilizers resulted significantly the highest green fodder yield, grain yield and economic returns under Sorghum $_{\text{fodder}}$ + Moth $_{\text{grain}}$ + Oat $_{\text{grain}}$ + Lucerne$_{\text{fodder}}$ fodder crop sequence.
- Application of Zn through zinc sulphate applied either every year or alternate year gives good response in terms of green fodder yield of cowpea and grain yield of barley in western Rajasthan.
- Forage production potential of sorghum + clusterbean inter crop with 100% seed rate of legume recorded the highest fodder yield and net returns under western Rajasthan
- Pearl millet + guar – Oat – Cowpea sequence has been found remunerative, which gave higher forage production and net returns on sustainable basis.
- For higher economic returns, oat crop should be left for seed production after one cut for green fodder at 75 days after sowing.
- For obtaining higher green fodder yield during kharif season, pearl millet should be grown in combination with guar in 2:2 or 1:1 row proportion or with cowpea in 2:2 row proportion.

- October 30 – November 10 is optimum period for sowing of fodder oat. Under good management condition, three cuts for green fodder can be taken.
- October 30 is optimum date of sowing for lucerne and for getting higher green fodder production. Cutting should be taken at three weeks' interval.

Seed Production and Availability

Bikaner centre is doing breeder seed production of fodder varieties of pearl millet, oat and cluster bean according to the indent received. Mainly, breeder seed production of RBC-2 variety of pearl millet and Kent variety of oat has been done in the past years.

Year	Crop	Variety	Breeder seed indented by DAC (q)	Produced by breeder (q)
2008-09	Pearl millet	RBC-2	1.75	2.00
	Oat	Kent	23.00	55.00
2009-10	Pearl millet	RBC-2	0.35	0.35
	Guar	RGC-1031	40.00	43.00
	Oat	Kent	10.00	34.00
2010-11	Pearl millet	RBC-2	0.50	0.50
	Oat	Kent	12.50	27.53
2011-12	Pearl millet	RBC-2	0.50	0.50
2012-13	Pearl millet	RBC-2	0.20	0.20

Future Strategies

Although good varieties of the forage crops and grasses are available at this time for the region, there is high need for the region to get more and continuous attention for genetic improvement of forage crops with their quality seed production for sustainable livestock production. Bikaner centre of AICRP on Forage Crops is at present an important centre for breeder seed production of fodder pearl millet and oats. Research efforts have revealed that seed production of lucerne can be done in areas around Bikaner region with production of about 2.5 q/ha seed. Farmers should take advantage by growing improved varieties of fodder grasses and crops and following improved technology of fodder production.

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