Improved seed production technologies for important fodder crops and grasses with notified varieties/ for different agro-climatic conditions/zones

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Introduction

- Seed is the crucial input of agriculture and most essential component for enhancing the production and productivity of agricultural crops
- non-availability of quality seed in sufficient quantities. As per an estimation only 25-30% of required quantity of quality seed is available in cultivated fodders and <10% in range grasses and legumes in India.
- The fodder crops are represented by several cereals, legumes and grasses. Out of these only few crops are under proper seed chain. During Kharif season 7 crops and during rabi season 4 crops are under seed multiplication programs. Out of these 11 crops sorghum, berseem, lucerne, maize and bajra occupies more than 90 % of area under fodder cultivation.

- Even though there is huge demand for fodder and fodder seed it is not being transformed into breeder seed indent. The main reason for this low turnout is absence of organized market.

Table 1: Estimated National Seed Requirement & Status of Breeder Seed Produced

Crop	Area (mha)	Average Seed Rate (kg/ha)	Estimated seed requirement			Breeder seed produced (T) during 2012-13
			Certified Seed (T)	Foundation seed (T)	Breeder Seed (T)	
Maize	0.9	20	18000	180.0	1.8	18.160
Sorghum	2.6	10	26000	260.0	2.6	2.975
Bajra	0.9	10	9000	112.0	1.4	0.575
Oat	0.25	75	18700	937.5	46.9	53.960
Berseem	2.0	20	40000	1600.0	64.0	7.725
Lucerne	1.0	15	15000	562.5	21.6	0.104
Cowpea	0.3	20	6000	200.0	6.7	0.37
Guar	0.2	20	4000	89.0	2.0	37.22
		Total	**136700**	**3941.0**	**147.0**	**121.089**

Requirement of breeder, foundation and certified seeds by 2020

Crop	Area (lakh ha)	Seed rate (kg/ha) for		Seed multiplication ratio	Seed (tonnes)		
		Fodder production	Seed production		Certified	Foundation	Breeder
Guar	2.0	35	15	60	7020	117	2.0
Maize	9.0	40	20	75	36000	480	6.4
Sorghum	26.0	40	10	100	104000	1040	10.4
Cowpea	3.0	40	15	40	12000	300	7.5
Pearl millet	9.0	20	10	80	18000	225	2.8
Oat	2.5	100	75	20	25000	1250	62.5
Berseem	20.0	25	20	25	50000	2000	80.0
Lucerne	10.0	25	15	26	24750	950	36.5
Total					277000	6362	208.1

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Forage breeder seed production (q) during the last decade

Crop	2006-07		2007-08		2008-09		2009-10		2010-11		2011-12		2012-13		2013-14		2014-15		2015-16		Total	
	I*	P**	I*	P**	I*	P**	I*	P**	I*	P**	I*	P**	I*	P**	I*	P**	I*	P**	I*	P**	I*	P**
Kharif																						
Guar#	66	448	422	841	450	842	480	389	248	520	277	575	289	431	344	206	342	273	269	257	3232	5053
Maize	30	65	106	91	74	75	54	72	63	94	75	77	99	109	89	138	136	153	76	83	835	1027
Sorghum	24	20	36	19	27	27	55	221	23	29	34	53	33	74	33	19	39	64	17	28	351	562
Cowpea	12	29	11	20	11	21	8	17	9	16	43	12	29	14	20	10	5	2	2	3	167	163
Teosnite	5	5	4	4	9	5	4	4	5	10	0	-	-	-	-	-	-	-	-	-	31	33
bajra	3	3	3	5	3	4	1	2	2	9	6	6	6	9	3	6	0	1	0	4	28	54
Ricebean	2	2	2	2	2	2	3	3	-	-	3	3	3	2	3	4	-	-	-	-	20	21
Rabi																						
Oat	228	380	255	339	314	422	224	371	202	305	1082	890	1278	611	402	398	283	216	358	373	4821	4580
berseem	71	72	73	72	76	126	45	60	69	50	94	84	87	77	35	37	41	41	47	51	689	706
Lucerene	18	18	20	11	21	20	8	8	6	6	13	7	7	7	6	5	4	2	5	4	115	98
Gobhi sarson									0	1	1	2	0	2	0	0	-	-	0	0	2	6
Total	456	1043	931	1403	985	1543	883	1145	627	1040	1627	1708	1832	1336	935	824	850	751	774	803	10289	12302

I*: Indent; P**:Production; # includes grain and fodder varieties.

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Varieties of forage crops in the seed chain during 2004-05 to 2017-18

Crop	Number of varieties	
	Released/notified	Seed chain
Guar	14	05
Maize	03	03
Sorghum	31	19
Cowpea	34	12
Teosinte	01	01
Pearl millet	17	07
Rice bean	12	02
Oat	26	18
Berseem	16	15
Lucerne	13	05
Gobhi sarson	03	03
Total	170	90

Forage crop varieties in seed chain during last decade

Berseem			
Varieties	**Year of notification**	**Area of adoption**	**Specific features**
Mescavi	1975	All berseem growing areas of India	Highly adaptable and productive, high crude protein, multi-cut
Pusa Giant	1975	All berseem growing areas of India	Thick stem, broad leaf, bold seed
BL 1	1978	Punjab	
JB 1	1981	Madhya Pradesh and CG	
Wardan	1982	All berseem growing areas of India	Tolerant to bacterial wilt and other diseases
BL 10	1985	Punjab, Haryana, Delhi, Himachal Pradesh and Jammu & Kashmir	BL 10
BL 22	1988	Temperate zone, Jammu &Kashmir, Haryana, Punjab and Himachal Pradesh	Long duration, green fodder up to June end
BL 2	1989	Punjab	
Bundel Berseem 2 (JHB 146)	1997	P u n j a b , H a r y a n a , Uttarakhand, Uttar Pradesh, Madhya Pradesh Maharashtra	Fairly tolerant to acidic conditions
Bundel Berseem 3	2001	Asom, Bihar, Jharkhand, Odisha, Uttar Pradesh and West Bengal	Tolerant to stem rot, root rot and downy mildew diseases
Jawahar Berseem 5	2005	Madhya Pradesh, Uttar Pradesh, Maharashtra, Gujarat, Chhattisgarh	
BL 180	2006	P u n j a b , H a r y a n a , Uttarakhand, Jammu & Kashmir and Himachal Pradesh	Long duration
Hisar Berseem 1	2006	Haryana	Long duration
BL 42	2007	Punjab, Haryana and Himachal Pradesh	Resistant to stem rot
Hisar Berseem 2	2014	Haryana	Long duration

Lucerne			
Varieties	**Year of notification**	**Area of adoption**	**Specific features**
Sirsa Type 9	1975	Punjab, Haryana, Delhi and Uttar Pradesh	Quick growing with deep green foliage
CO 1	1982	Tamil Nadu	Perennial
Anand 2	1984	Gujarat, Maharashtra and Rajasthan	
RL 88	1996	All lucerne growing areas of India	Perennial
Anand Lucerne 3 (AL 3)	2009	Gujarat and Maharashtra	High regeneration capacity
Guar			
Guara 80	1973	Punjab and Haryana	Resistant to Xanthomonas cyamopsis
Ageti Guara 112	1983	Punjab	
Bundel Guar 1	1993	Arid and semi-arid zone of Punjab, Haryana and Rajasthan	Moderately resistant to leaf blight, lodging resistant and drought tolerant
Bundel Guar 2	1995	Semi-arid zone of Punjab, Haryana, Rajasthan, Gujarat, Uttar Pradesh and Madhya Pradesh	
Guar Kranti	2005	Rajasthan	Resistant to lodging, nutritive fodder, suitable for late sown areas

Maize			
African Tall	1983	All forage maize growing areas in the country	Resistant to major foliar diseases and insect pests
J 1006	1992	Punjab,Haryana, Himachal Pradesh and western Uttar Pradesh	Resistant to Maydis blight, brown striped downy mildew and stem borer
Pratap Makka Chari 6	2009	Punjab, Haryana, Rajasthan and western Uttar Pradesh	Forage harvest in 60 days. Tall, thin stemmed, tolerant to stem borer, nematodes and leaf blight
Bajra			
Giant Bajra	1985	All forage pearl millet growing areas of India	Good for hay and silage making, moderately resistant to downy mildew and ergot diseases
Raj Bajra Chari 2	1990	Rajasthan	R e s i s t a n t t o f o l i a r diseases and insect pests, adaptability to saline condition
CO 8	1993	Tamil Nadu	Soft stem, high leaf stem ratio, short duration, highly palatable
FBC 16	2007	All forage pearl millet growing areas of India, particularly Punjab	High fodder productivity and low in oxalates
PCB 164	2007	All forage pearl millet growing areas of India, particularly Punjab	Early maturing
Avika Bajra Chari 19	2009	Ra j a s tha n , Punj ab, Haryana, Uttar Pradesh and Uttrakhand	Resistant to downy mildew, blast and nematodes, dual purpose
BAIF Bajra 1	2010	Ra j a s tha n , Punj ab, Haryana, Uttarakhand, Uttar Pradesh, Gujarat, M a d h y a P r a d e s h , Maharashtra	Moderately resistant to downy mildew, leaf blight and leaf spot

Sorghum			
Varieties	Year of notification	Area of adoption	Specific features
MP Chari	1978	All forage sorghum growing areas in the country	Fast regeneration, multi-cut
Pusa Chari 6	1980	Pusa Chari 6	
HC 136	1982	All forage sorghum growing areas in the country	Dual purpose, tolerant to foliar diseases
Pusa Chari 23	1985	All forage sorghum growing areas in the country	Multi-cut, suitable for early as well as late planting, tolerant to drought and flood
Pusa Chari 9	1985	All sorghum growing areas in the country under irrigated conditions	Tolerant to major insects, pests, drought and temporary water logging
HC 171	1987	All forage sorghum growing areas in the country	Resistant to foliar diseases
Punjab Sudex Chari 1	1995	Punjab	Multi-cut, highly resistant to anthracnose
HC 308	1996	All forage sorghum growing areas in the country	Resistant to foliar diseases, tolerant to drought, suitable for both early and late sown conditions
Pant Chari 5	1999	All forage sorghum growing areas in the country	Highly resistant to anthracnose, zonate leaf spot and other foliar diseases
CO (FS)29	2001	Tamil Nadu	Tolerant to shoot-fly/ stem borer, multi-cut, perennial, high in crude protein and digestibility
CSV 32 F	2015	Maharashtra, Karnataka, Tamil Nadu, Madhya Pradesh, South Gujarat, Telangana and Tamil Nadu	Tall, drooping leaves, bold seed, stem borer resistant and drought tolerant

Sorghum			
Gujrat Fodder Sorghum 5	2005	Gujarat	Resistant to leaf spot and grain mold diseases
CSH 20MF 2219 (A & B)	2005	Uttar Pradesh, Uttarakhand, Delhi, Haryana, Punjab, Rajasthan, Bihar and Gujarat	Multi-cut, high leafiness, resistant to major foliar diseases
Pusa Chari 615	2006	NCR, Delhi	Tolerant to major foliar diseases and insect pests
Pant Chari 6	2006	Uttarakhand	Resistant to major foliar diseases, zonate leaf spot, downy mildew, grey leaf spot, anthracnose, sooty stripe
HJ 513	2007	Haryana	Dual purpose, tolerant to major foliar diseases, grey leaf spot, zonate leaf spots, sooty stripe
CSH 24MF 467 (A & B)	2009	All forage sorghum growing areas of India	Resistant to foliar diseases, non-lodging, good yielding ability, thick, juicy and semi-sweet stem
Pratap Chari 1080	2010	Forage sorghum growing regions in Rajasthan state with loam to light soils and moderate to low rainfall	Single cut, tan pigmentation
CSV 30 F	2014	All forage sorghum growing areas of India	Non-tan, drooping leaf, tolerant to shoot fly, stem borer and foliar diseases

Cowpea			
Varieties	Year of notification	Area of adoption	Specific features
EC 4216	1978	All forage cowpea growing areas of India	High crude protein and moderately drought tolerant
GFC 3 (Gujarat Forage Cowpea 3)	1980	Gujarat	Good quality
UPC 5286	1982	All forage cowpea growing areas of India	Resistant to YMV, root/ collar rot, anthracnose and BLB
UPC 5287	1986	All forage cowpea growing areas of India	Resistant to YMV and pod borer
Bundel Lobia 2	1994	Punjab, Haryana, Rajasthan, Uttrakhand and Uttar Pradesh	Good yielding
UPC 8705	1996	All forage cowpea growing areas of India	Dual purpose, stay green
Haryana Lobia 88	1997	Haryana	Resistant to cowpea YMV
UPC 9202	1999	Madhya Pradesh, Gujarat, Maharashtra and Uttar Pradesh	Dual purpose
CO (FC) 8	2005	Tamil Nadu	Indeterminate type of growth, resistant to cowpea YMV and root rot
CL 367	2006	Punjab	Tolerant to stem anthracnose and YMV
UPC 625	2009	Himachal Pradesh, Punjab, Haryana, Rajasthan, Gujarat, Maharashtra, Uttar Pradesh, Madhya Pradesh, Bihar, West Bengal, Asom and Jharkhand	Resistant to CMV, anthracnose, collar rot and bacterial blight
UPC 628	2010	Plains and lower hills of Uttarakhand	Resistant to YMV, collar / root rot, anthracnose, leaf blight, pod borer and flea-beetle

Oat			
Varieties	Year of notification	Area of adoption	Specific features
Kent	1975/ 1978	All oat growing areas of India	Resistant to rust, blight diseases and lodging, medium late type
OS 6	1984	All oat growing areas of India	Tolerant to major diseases and pests
JHO 822	1989	Uttar Pradesh, Madhya- Pradesh, Gujarat and Maharashtra	Plump and bold seed
UPO 212	1990	Punjab, Uttarakhand, Uttar Pradesh, Madhaya Pradesh, Rajasthan, Haryana, Gujarat and Maharashtra	Multi-cut
Sabazar	1990	Temperate and high altitude areas – Jammu & Kashmir	Dual purpose
HJ 8	1998	Haryana	Two cuts
JHO 851	1998	All oat growing areas of India	Tolerant to crown rust, leaf blight, Sclerotial wilt, multi-cut, high protein
JHO 99-2	2005	Punj ab, Ra j a s than, Haryana, Uttarakhand, Bihar, Odisha, West Bengal, Uttar Pradesh and Asom	Tolerant to major disease and pest
Bundel Jai 2004 (JHO 2000-4)	2006	Punjab, Haryana, tarai region of Uttrakhand and Uttar Pradesh, Rajasthan, eastern Uttar Pradesh, Jharkhand, West Bengal, Odisha and Asom plains	Tolerant to root rot, crown rust, leaf blight and powdery mildew, good quality
Phule Harita	2007	Maharashtra	Resistant to leaf blight disease, multi cut

Oat			
Bundel Jai 991(JHO 99-1)	2007	Hilly zone of Jammu & Kashmir and Himachal Pradesh	Moderately resistant against leaf blight, nematodes, grasshoppers and aphids
RO 19	2007	Ra j a s tha n , Punj ab, Haryana, Uttar Pradesh, Madhya Pradesh, Gujarat, Maharashtra,	Multi-cut, resistant to leaf spot, high crude protein
OS 346	2010	Madhya Pradesh, Gujarat, Maharashtra and southern Uttar Pradesh	Bold seeded, better in nutritional quality; moderately resistant to leaf blight
JO 03-91	2010	Madhya Pradesh, Gujarat, Maharashtra and southern Uttar Pradesh	Tolerant to leaf blight, Sclerotium root rot and powdery mildew
NDO 1	2011	Uttar Pradesh	Suitable for salt affected soil
NDO 2	2012	Uttar Pradesh	Suitable for salt affected soil
Shalimar Oat 1 (SKO 20)	2013	Temperate areas of Jammu & Kashmir	Long and wide lemma
OL 10	2016	Punjab irrigated areas	Multi-cut
Gobhi Sarson			
GSL 1	1987	Punjab, Jammu and Kashmir, Haryana, Delhi, eastern Rajasthan	GSL 1
HPN 1	1995	Himachal Pradesh	HPN 1
Him Sarson 1	2007	Jammu & Kashmir, Uttarakhand, Himachal Pradesh	Tolerant to temperature extremes and lodging
Rice bean			
Bidhan 1	2001	West Bengal, Odisha, Jharkhand, Asom, Sikkim, Mizoram, Manipur, Nagaland and Bihar	Tolerant to drought and cold, dual purpose
Bidhan 2	2005	West Bengal, Odisha, Asom, Jharkhand , Sikkim, Mizoram, Manipur, Bihar and Nagaland	

Recent indent for 2018-19 (*Rabi*) and 2017-18 (*Kharif*) reflect demand for many old varieties

Crop	Year	Name of the variety	DAC Indent (q)
Berseem	2007	BL-42	11.06
	2006	BL-180	1.90
	1985	BL-10	12.28
	1978	BL-1	3.0
	1997	BB-2 (JHB 146)	0.20
	2001	BB-3	9.0
	1982	Wardan	5.4
	2006	H. Berseem-2	1.40
	1975	Mascavi	0.80
	1993	UPB-110	0.10
		Total	45.14

Crop	Year	Name of the variety	DAC Indent (q)
Lucerne	1996	RL-88	0.20
	1984	Anand-2	3.4
	2009	AL-3 (ANAND Lucerne -3	1.30
		Total	4.90
Gobhi Sarson	2009	Him Sarson-1	0.02
		Total	0.02
Maize		African Tall	44
Sorghum		Pratap Makka Chari-6, J-1006	39.15
Pearl Millet		BAIF Bajra-1	1.0
Cowpea		UPC-8705, EC 4216	8.1

Crop	Year	Name of the variety	DAC Indent (q)
Oat	2014	OL-10	35.05
	1975	Kent	371.45
	2007	RO-19	5.0
	2015	JO-03-93	25.0
	1990	UPO-212	52.50
	2006	JHO-2000-4	5.0
	2005	JHO-99-2	5.0
	1989	JHO-882	20.0
	2016	JHO 2009-1	25.0
	2016	JHO 2010-1	20.0
	2015	OS-377	25.00
	1982	OS-6	5.0
	1998	Haryana Javi -8	7.60
	2013	Shalimar Oat-1 (SKO -20)	10.00
	2016	Shalimar Oat-3	30.0
	2010	NDO-1	4.0
		Total	654.6

Fodder crop varieties released/notified during last five years

Crop	Variety	identification / notification	Breeding institution	Recommended area
BxN hybrid	BNH-10	2015	BAIF, Urulikanchan	All India except Hill
	CO (BN) 5	2014	TNAU, Coimbatore	All India
	Phule Gunwant	2017	MPKV, Rahuri	Maharashtra
	PBN 342		PAU, Ludhiana	Punjab, Assam, Haryana, Rajasthan, Odhisha, Tamil Nadu, Karnataka.
Lucerne	Anand Lucerne-4	2016	AAU, Anand	Punjab, Rajasthan
	Lucerne CO-2	2015	TNAU, Coimbatore	Tamil Nadu
	RRB 07-1	2016	SKRAU, Bikaner	Punjab, Rajasthan
	TNLC-14	2017	TNAU, Coimbatore	Telengana, Andhra Pradesh, Karnataka and Tamil Nadu
Pearl millet	RBB-1	2013	SKRAU, Bikaner	Rajasthan
	NDFB-5	2014	NDUA&T, Faizabad	Uttar Pradesh
	NDFB-1	2013	NDUA&T, Faizabad	Uttar Pradesh
	NDFB 11	2014	NDUA&T, Faizabad	Uttar Pradesh
	PAC-981	2014	Advanta Private Ltd.	Punjab, Haryana, Rajasthan, Gujarat, MP, Maharashtra, UP
	Moti bajra	2016	PJTSAU, Hyderabad	Telangana
	APFB-09-1	2016	PJTSAU, Hyderabad	Telangana
	Raj Bajra-1(RBB-1)	2016	SKRAU, Bikaner	Rajasthan

Crop	Variety	identification / notification	Breeding institution	Recommended area
Oat	NDO-2	2013	NDUA&T, Faizabad	Uttar Pradesh
	JHO 2012-2	2017	IGFRI, Jhansi	Telengana, Andhra Pradesh, Karnataka and Tamil Nadu
	OS-424	2017	CCS HAU, Hisar	J&K, HP and Uttarakhand
	SKO-225	2017	SKUAST-K, Srinagar	J&K, HP and Uttarakhand
	OL-1802-1	2017	PAU, Ludhiana	Rajasthan, Haryana, Punjab, Uttarakhand and Western UP
	OL-1769-1	2017	PAU, Ludhiana	UP, Maharashtra, Gujarat, Chhattisgarh and MP
	OL 1760	2017	PAU, Ludhiana	Telengana, Andhra Pradesh, Karnataka and Tamil Nadu
	NDO-10	2013	NDUA&T, Faizabad	Uttar Pradesh
	JHO-2010-1	2013	IGFRI, Jhansi	Andhra Pradesh, Karnataka, TN
	OS-377	2015	HAU, Hisar	UP, Maharashtra, Gujarat, MP, CG
	JO-03-93	2015	JNKVV, Jabalpur	MP, Gujarat, Maharashtra, UP
	JO-03-91	2014	JNKVV, Jabalpur	MP, Gujarat, Maharashtra and UP
	JO-2000-61(JO-2)	2012	JNKVV, Jabalpur	Madhya Pradesh
	SKO-96	2016	SKUAST, Srinagar	HP, J&K
	UPO-06-1	2016	GBPUAT, Pantnagar	Uttarakhand
	OL-10	2016	PAU, Ludhiana	Punjab
	Pant forage oat 3	2016	GBPUAT, Pantnagar	Uttarakhand
	Pant forage oat 4	2016	GBPUAT, Pantnagar	Uttarakhand
	NDO-711	2014	NDUAT, Faizabad	Uttar Pradesh

Crop	Variety	identification / notification	Breeding institution	Recommended area
Oat	UPO-06-2	2013	GBPUAT, Pantnagar	Uttarakhand
	JHO 2009-1	2016	IGFRI, Jhansi	Central zone
	OS-403	2015	HAU, Hisar	NE, NW, South zone
	OS 405	2016	CCS HAU, Hisar	Central Zone of India
	RO-11-1	2017	MPKV, Rahuri	All India (except hill zone)
	OL 1802	2016	PAU, Ludhiana	Central zone
Oat	OL 1804	2016	PAU, Ludhiana	North East Zone
Berseem	JSBC-1	2017	IGFRI, Jhansi	Maharashtra, Rajasthan, Punjab, Haryana, UP and MP
	HB-2	2014	HAU, Hisar	Haryana
cowpea	CO 9	2016	TNAU, Coimbatore	Tamil Nadu
	TNFC 0926	2016	TNAU, Coimbatore	NEZ
	Aiswarya	2013	KAU	Southern Kerala
	IL 1177	2012	IGFRI, Jhansi	Jharkhand, Odhisha, WB, UP
	MFC 09-1	2016	UAS, Mandya	Karnataka
	Vijaya	2016	PJTSAU, Hyderabad	Telangana

Rice bean	KRB-19	2016	BCKVV, Kalyani	North eastern region
	Shyamalima	2016	AAU, Jorhat	Assam
	Surabhi	2013	LKAU, Vellayani	Southern Kerala
	JRBJ05-2	2016	JNKVV, Jabalpur	MP, Chhatishgarh, & NEZ
Lathyrus	Madhuri	2016	AAU, Jorhat	Assam

Varieties in last five years for grasses

Crop	Variety	identification / notification	Breeding institution	Recommended area
Marvel grass	Phule Marvel-06-40	2015	MPKV, Rahuri	Maharashtra
	Phule Govardhan	2016	MPKV, Rahuri	Maharashtra
	Marvel-09-4	2017	MPKV, Rahuri	Gujarat, Uttar Pradesh, Madhya Pradesh and Maharashtra
	JHD-2013-2	2017	IGFRI, Jhansi	Punjab and Rajasthan
Anjan Grass	GAAG-1	2012	AAU, Anand	Gujarat
	RCCB-2	2016	SKRAU, Bikaner	Rajasthan
	RCC-10-6	2017	MPKV, Rahuri	Punjab, Rajasthan, Gujarat, Uttar Pradesh and Maharashtra.
Guinea Grass	JHGG 08-1	2016	IGFRI, Jhansi	All India
	RSDGG-1	2016	IGFRI, Jhansi	All India
	TNGG-062	2016	TNAU, Coimbatore	All India
	CO (GG) 3	2014	TNAU, Coimbatore	All India

Crop	Variety	identification / notification	Breeding institution	Recommended area
Setaria Grass	S-18	2013	HPKV, Palampur	HP and Uttrakhand
Tall fescue	Hima-14	2013	HPKV, Palampur	HP, Uttarakhand,J& K
Sewan grass	RLSB 11-50	2016	SKRAU, Bikaner	Rajasthan
Clitoria ternatea	JGCT-2013-3	2017	IGFRI, Jhansi	Maharashtra, Rajasthan, Punjab, Haryana, south UP, MP and Gujarat

CONSTRAINTS IN FODDER SEED PRODUCTION

- ***Indeterminate growth:*** The range species under natural conditions, are acclimatised for indeterminate growth leading to non-synchrony in reproductive and vegetative growth. This is one of the major impediments for commercial or large scale cultivation and mechanization.
- ***Uneven maturity***: The maturity varies from plant to plant and from branch to branch with in a plant. Even with in inflorescence / panicle starting from anthesis to seed ripening is observed. This highly non uniform maturity makes it impossible to realize the full potential of seed production and difficulty in harvesting.
- ***Seed shattering***: In range species the easy shredding of the seed immediately after maturation leads to loss of seed during harvesting.
- ***Blank seed***: The reasons for this poor ovule to seed ratio are unknown. This is one of the main reasons for low germination percentage in grasses.
- ***Seed dormancy***: Most of the range species have varying degrees of either physical or physiological dormancy. In nature it is highly useful trait but for commercial cultivation it is a negative trait.

- ***Influence of Climatic factors***: Seed production in range species is highly influenced by the photoperiod, thermo period, humidity etc. The quality and quantity will be effected under varying climatic conditions.
- ***Low density of ear-bearing tillers***: Profuse tillering is observed in many range species. But all the tillers won't flower and only 30-50 % tillers possess inflorescence at the time of peak flowering.
- ***Lodging***: Due to prolonged and vigorous vegetative growth lodging of seed crop is a common problem.
- ***Poor Harvest index***: The harvest index is low mainly because of higher biomass production. Only 2-3% harvest index is observed in many tropical grasses.
- ***Lack of seed production technology***: The cultivated as well as range species lacks specific seed production technology. In case of cultivated fodder since the varietal development is focussed on fodder production, seed production technology is not well studied. In range species lack of large scale production and because of above said problems no specific seed production technology is available.

Strategies for increased seed production

- Creating awareness to use quality seed of improved varieties.
- Increasing the seed replacement rate from the present 2-3 % to at least 20%.
- Seed chain should be followed to produce sufficient quantity of certified seed for farmers
- Improvement of seed chain network
- Seed production through farmer participatory approach
- Improvement of proper marketing facilities
- Research to increase the ovule to seed ratio in forages
- Scientific studies on management practices to increase the seed yield.
- In-depth studies on grass seed germination and dormancy problems.
- Research on development of cultivable pasture varieties.
- Channelizing the existing demand towards entrepreneurship development
- Improved crop management
- Village Seed Banks are to be developed.

Crop management practices for forage crops seed production

1. Soil	
Crop	**Soil Type**
Sorghum	Deep alluvial or heavy fertile soil with good moisture retention capacity
Maize	Sand to clay loam soil, well drained, pH 6.5
Pearl millet	Sandy loam, free from salinity or alkalinity
Guar	Light to medium fertile sandy loam soil, pH up to 8.5
Cowpea	Sandy loam soil, well drained, pH 5.0 to 6.5
Oat	Loam to clay loam soil, well drained, pH up to 8.5
Berseem	Well-drained clay loam soil, free from acidity and salinity , pH 7 to 8
Lucerne	Sandy loam to clay soil, free from salinity or alkalinity

2. Spacing and seed rate		
Crop	**Spacing (cm)**	**Seed rate (kg/ha)**
Maize	60 X 20 cm	20
Sorghum	45 X 15 cm	10-12
Pearl millet	45 X 10 cm	5
Cowpea	45-50 X 15 cm	18-20
Guar	45 X 15 cm	15
Oat	30 X 5	60 (medium size seed) 40 (small size seed) (JHO-851)
Berseem	40 X 3	15-20
Lucerne	50 X 3	12-15

3. Nutrient requirement and management

Crop	Nutrient requirement (kg/ha)			Time of application	
	N	P_2O_5	K_2O	Basal dose	Top dressing
Maize	120	60	40	50% N and entire amount of P and K	¼ dose of N at knee-height and tasseling stage
Sorghum	90	40	30	50% N and entire amount of P and K	50% N 30-45 days after sowing (knee-height stage)
Pearl millet	80	40	30	50% N and entire amount of P and K	50% N 30-45 days after sowing
Cowpea	20	60	20	Entire amount of N, P and K	-
Guar	20	40	25	Entire amount of N, P and K	
Oat	80	40	30	50% N and entire amount of P and K	50% N 30-45 days after sowing

Berseem	50	60	40	20 kg N and entire amount of P and K	10 kg N/ha after each cut
Lucerne	20	60	40	Entire amount of N, P and K	-

4. Weed control

Forage crops weed flora	
***Kharif* Season**	
Grassy	*Elusine indica, Cynodon dactylon, Echinochloa colona, Echinochloa crusgalli, Setaria glauca, Digitaria sanguinalis, Dactyloctenium aegyptium, Sorghum halepense.*
Broad-leaf	*Commelina diffusa, Commelina benghalensis,Trianthema portulacastrum, Ageratum conyzoides, Phyllanthus niruri, Physalis minima, Euphorbia hirta, Digera arvensis, Leucas aspera , Celosia argentea , Cucumis melo, Tridax procumbens, Amaranthus viridis, Amaranthus polygamus, Amaranthus spinosus.*
Sedges	*Cyperus rotundus,Cyperus iria, Cyperus difformis.*

***Rabi* Season**	
Grassy	*Poa annua, Cynodon dactylon, Phalaris minor, Digitaria sanguinalis, Avena fatua*
Broad- leaf	*Anagalis arvensis, Chenopodium album, Convolvules arvensis, Melilotus alba, Melilotus indica, Lathyrus aphaca, Asphodelus tenuifolius, Cichorium intybus, Coronopus didymus, spergula arvensis Eclipta alba, Sonchus oleraceus, Sonchus asper, Medicago denticulate, Medicago auxalis, Trifolium resupinatum, Rumex dentatus, Physalis minima.*
Sedges	*Cyperus rotundus.*

Herbicides for different forage crops weed control				
Crops	**Herbicide**	**Dose (a.i. kg/ha)**	**Time of application**	**Weeds Controlled**
Kharif forage crops				
Maize	Atrazine	1.0	2-3 DAS	Grassy & BLW
	2, 4-D	0.5-0.75	15-20 DAS	BLW
Sorghum	Atrazine	1.0	2-3 DAS	Grassy & BLW
	2, 4-D	0.5-0.75	15-20 DAS	BLW
Cowpea	Pendimethalin	0.75-1.0	2-3 DAS	Grassy & BLW
	Imazethapyr	0.1	15 -20 DAS	Grassy & BLW
Guar	Pendimethalin	0.75-1.0	2-3 DAS	Grassy & BLW
	Imazethapyr	0.1	15 -20 DAS	Grassy & BLW

Rabi forage crops				
Oat	2, 4-D	0.5-0.75	20 DAS	BLW
	Metsulfuron-methyl	0.004	20 DAS	BLW
Berseem	Imazethapyr	0.1	20 DAS	Grassy & BLW
	Fenoxaprop-p-ethyl	0.1	20 DAS	Grassy
Lucerne	Imazethapyr	0.1	20 DAS	Grassy & BLW
Grasses and legumes				
Bajra Napier Hybrid Guinea grass Anjan Grass Dinanath grass	2, 4-D	0.5-0.75	15-20 DAS	BLW
Stylo	Quizalofop-ethyl	0.05	20 DAS	Grassy

DAS – Days after sowing, BLW – Broad leaf weeds, a. i. – active ingredient

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Maize weedy plot

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Berseem weedy plot

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Imazethapyr @ 0.100 kg a.i. /ha applied plot 55 DAS

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Conventional tillage (Maize) – Conventional tillage (Berseem)

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Conventional tillage (Maize) – Zero tillage (Berseem)

5. Harvesting

Crop	Harvesting stage	Seed yield (tonnes/ha)
Maize	Harvest maturity with moisture content 20-24%	5-6
Sorghum	Ear head attains grain colour, 15-20% moisture in grain	1-1.2
Pearl millet	Seeds appear brown at maturity, 18-20% moisture in seed	1-1.5
Cowpea	Pods turn in brown colour or mottled in colour	0.8-1.0
Guar	Pods seed are brown and dry, seed moisture content is less than 14%.	1.2-1.5
Oat	Seed hardens and the straw turns in light yellow colour	2-2.5
Berseem	Straw turns in light yellow colour	0.4-0.5
Lucerne	Straw turns in light yellow colour	0.2-0.3

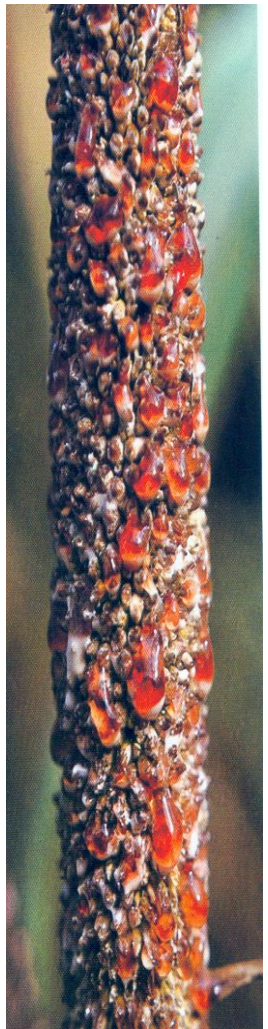
Critical interventions to enhance the seed yield of forage crops

Crop	Critical interventions
Cowpea	1. The sowing of cowpea crop should be completed between 25th June – 10th July. Delay in sowing increases the crop maturity period and affects the sowing of next crop and also reduces the cowpea seed yield. 2. To control the weed *Celosia argentea* sucessfully in cowpea the herbicide imazethapyr should be applied 2-3 days after sowing. 3. For control of weeds *Commelina diffusa* and *Commelina benghalensis* herbicide imazethapyr should be applied 20 days after sowing.
Oat	1. In oat total 80 kg N should be applied in three splits. Excessive nitrogen dose enhances crop lodging at the time of maturity and chaffy seed formation. 2. The oat crop where green fodder is not harvested at 55 days after sowing to minimize the seed loss due to lodging the crop should be sown at last week of November.

Berseem	1. To reduce the field loss of seed due to shattering the crop should be harvested at physiological maturity. 2. To achieve the higher seed filling and recovery the berseem last cut for green fodder should be completed up to last week of February. 3. Seed coating through polymer and nutrient mixture of N, P, K, Fe, Mg, Zn, Mn, B, Cu, Mo and Co enhances the germination and vigour of berseem seed. 4. Spray of 2% KNO_3 during panicle initiation stage helps in increasing the seed yield.
Guinea grass	1. Dipping the cut panicles of guinea grass in 100 ppm IAA solution uniformly seed maturity can be achieved. 2. Application of IAA @ 100 ppm during anthesis stage improves the seed germination by 15-20%.
Dinanath grass	1. Dinanath grass seed germination can be increased up to 90% by seed pelleting using fine clay.

Diseases in Forage Crops

In forages, the losses caused by diseases are not only in terms of green or dry forage yield and or grain (seed) yield, but also quality factors, which affect the re-growth period and canopy structure.



Crop	Pest	Loss in fodder/grains (%)
Sorghum	Diseases (General)	58
	Charcoal Rot	15-55
	Rust	50
	Anthracnose	48
	Leaf blight	45
Pearl-millet	Diseases (General)	30
	Downy mildew	10-45
Maize	Diseases (General)	13.2
	Maydis leaf blight	30
	Rust	32
Oats	Diseases	55
Cowpea	Yellow mosaic	10-100
	Leaf spots	47
Guar	Diseases (General)	75

RECENT IGFRI INNOVATIONS

External application of hormones in guinea grass:

The auxin treatment has improved the rate of germination as well as percent germination. Maximum germination (45 %) was recorded with 100 ppm dose of IAA compared to control (26%).

Invitro rooting in Napier Bajra Hybrid:

- Stem cuttings with 2-3 nodes
- Wrapped in paper towel layers in such a manner that one node is outside and one node is inside the wrapping. The wrapping was done with 6-7 layers of paper towel with 8 stem cuttings per layer. These wrapped stem cuttings were kept at 25^{o}C and 80% RH.
- Alternatively it can be kept at suitable ambient room temperature and maintaining moisture. The moisture was maintained by necessary water sprinkling. The roots were developed in 7-8 days' time making them ready for transplanting in the field.
- More than 85% rooting in the stem cuttings was observed and all the rooted slips have developed leaves within 10 days and survived in the field successfully after transplanting.

High density nursery in Napier Bajra Hybrid:

- Due to absence of seed setting, rooted slips are the sole method of propagation in BN hybrid. In general the rooted slips are collected from the grass tufts containing 5-10 cm long stems with 2-3 nodes and basal roots.
- After thorough investigation, it was found that the bi-nodal stem cuttings of at least 20 cm length and proper thickness are most promising material for high density nursery.
- The stems from the BN hybrids were collected and each stem was further chopped into 9-10 bi-nodal stem cuttings of approximately 20 cm length.
- The stem cuttings were closely planted in upward direction after a slant basal cut. Regular water supply was maintained for their establishment and growth.
- Within a fortnight, the cuttings started rooting and shooting and by 4 to 5 weeks they are ready for uprooting and transport.

Defluffing through mechanical means in Dinanath:

- Eight kg of *Dinanath* (*Pennisetum pedicellatum*) grass seed with fluff occupies 0.1 cubic m volume. The actual true seed (caryopsis) in this fluff will be less than half a kilogram and occupy very less volume due to its small size.
- The commonly used ‘cotton quilt batting machine’ with some adjustments was used for separation of true seed from the fluff of *Dinanath* grass. Since *Cenchrus, Chrysopogon* and other range species also possess similar fluff this newly developed technique paves the way for experimentation of bulk separation of their true seeds mechanically.

In vitro maturation studies in guinea grass

- The effect of hormonal solution on seed ripening was studied by dipping of cut panicles of *Panicum maximum* in hormonal solutions and water.
- The panicles dipped in IAA solution found to retain their viability for longer duration.
- In *Panicum maximum* under field conditions the spikelets shattered within a week time after anthesis. Therefore if the liveliness can be maintained in the cut panicles the shattering loss can be minimized and more mature seed can be collected than bulk harvest.

Enhancement of seed setting in grasses and tetraploid berseem

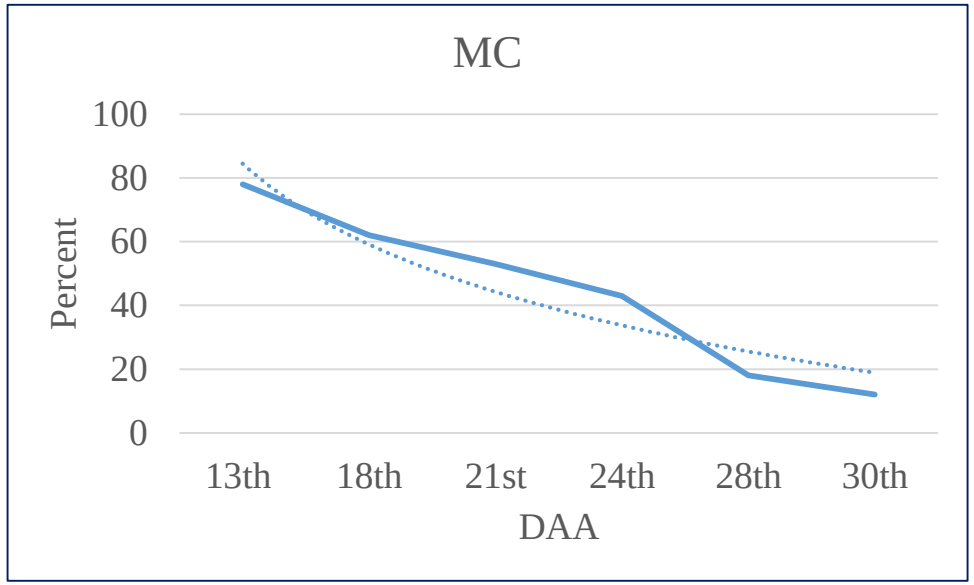
- Kinetin @ 100 ppm and TIBA @ 200 ppm increased seed setting by 10-20 % in *Chrysopogon fulvus and Sehima nervosum, two shy seeding grasses.*Low seed set in tetraploidBerseem,was improved with application of KNO_3 @ 100 ppm, TIBA @ 100 ppm and Borax @ 100 ppm

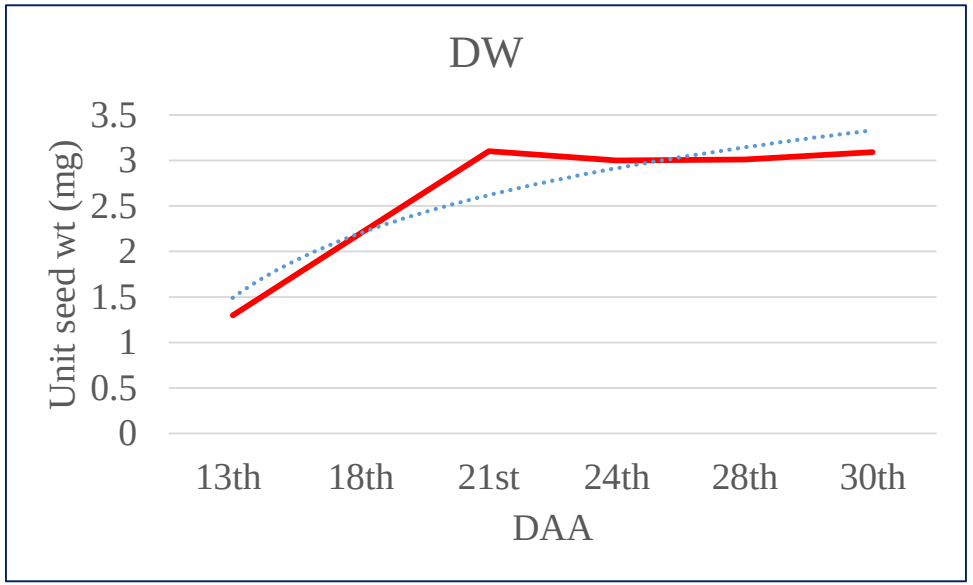
Enhancement of berseem seed productivity through harvest management

A proper stage for harvesting the berseem was identified to reduce the seed shedding during harvesting. The harvesting at physiological maturity followed by field drying enhanced the productivity by almost double. A yield of 4-6 q/ ha was achieved using this method compared to 2 q/ha as per normal harvesting method. This crop management technique is having high potential to enhance the berseem seed yield. The seed producers will be highly benefitted with the enhanced productivity in berseem without any additional cost.

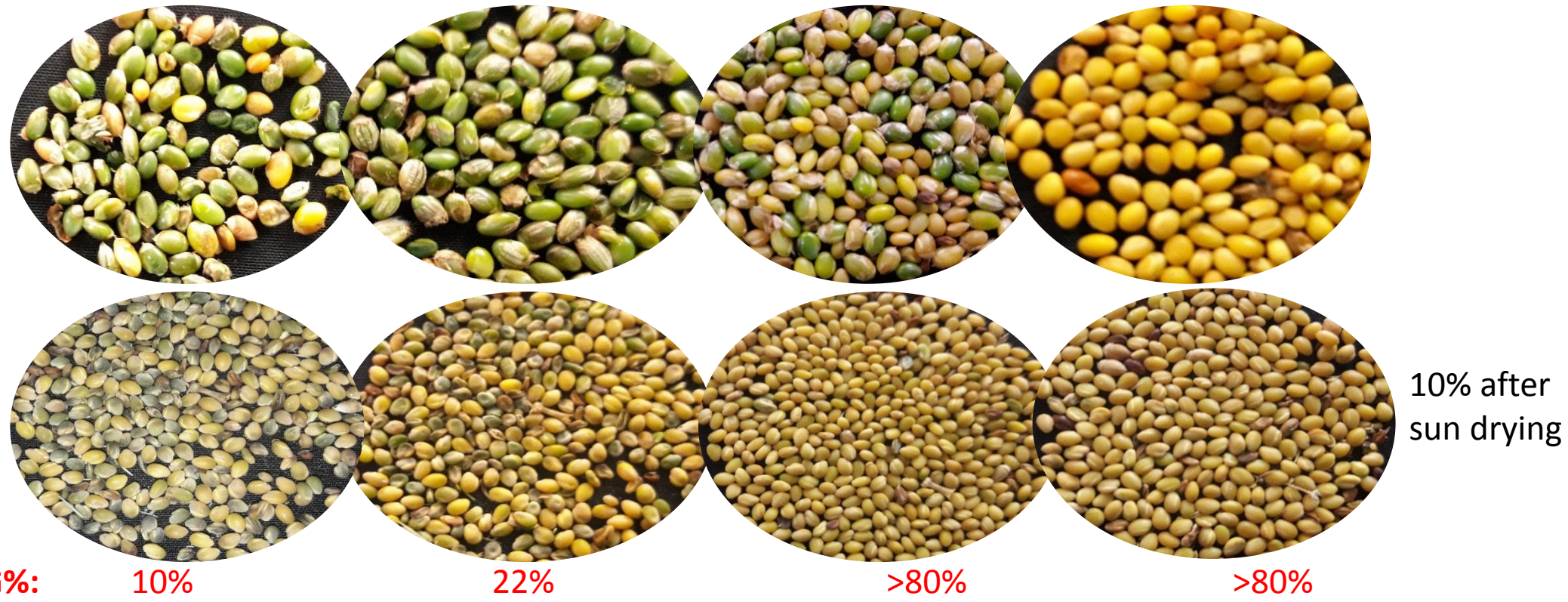
Seed moisture and dry weight dynamics

- Maximum seed weight is attained at 42% seed moisture
- However, different type of seed in a lot at a given point of time will require some modeling work due draw conclusion
- Further, what is the proportion of flower heads containing such seeds add alittle complexity





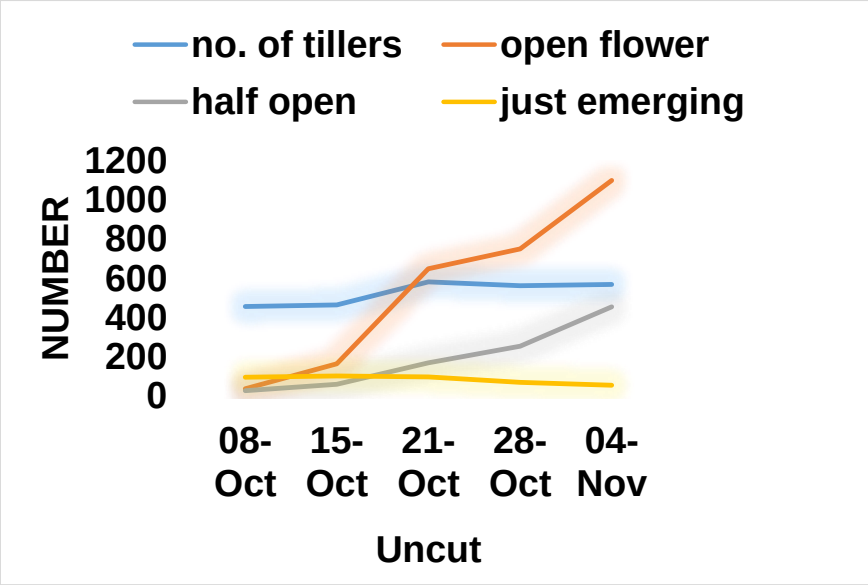
Identification of physiological and harvest maturity stage in berseem

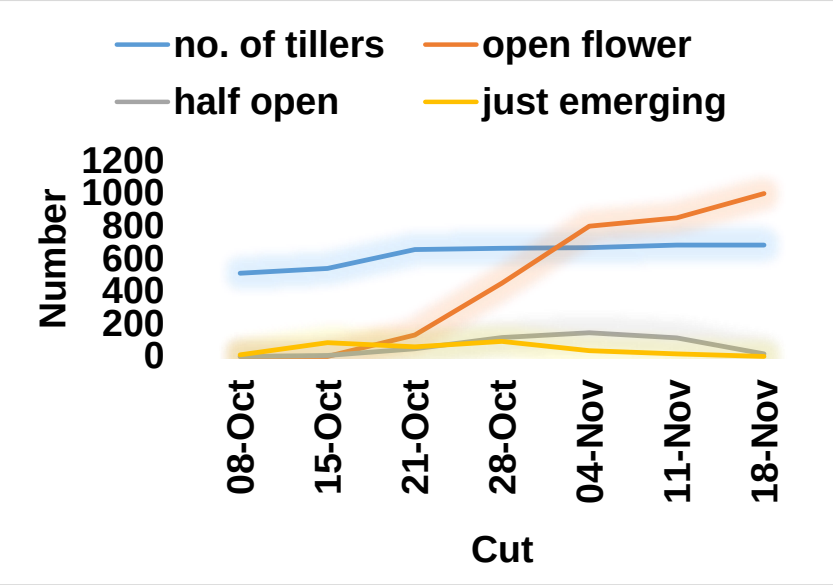


DAA= days after anthesis; MC= moisture content; G= germination;

Post harvest losses in dinanath grass seed

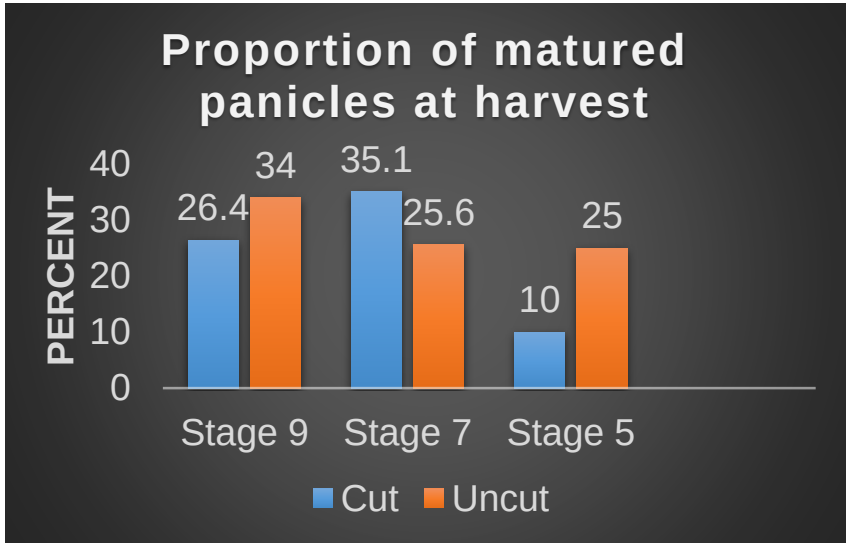
Cutting led to synchronized maturity in Dinanath grass





Yield (q/ha)	
Cut	**Uncut**
23 q/ha	**26.5 q/ha**

Proportion matured panicles outnumbered young panicles in cut crop whereas uncut crop has large proportion of young panicles also. Further seed yield is not severely compromised as compared to normal harvest (5-7 q/ha) in both conditions.



Coating of forage seeds

- New combination of coating material, nutrients and hormone has been developed for Berseem and cowpea
- Improves storability and vigour of seeds

Pelleting of grass seeds

- Modified method of pelleting has been developed
- Improves establishment in difficult terrains like ravines, hills, forests, etc.
- Provides options for mechanization and aerial seeding


Thank You