

Annual Progress Report: 2016-17

8. Research Highlights of AICRP Centres

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8. Research Highlights of AICRP Centres

1. Athiyandal

1. **Name of centre and mandate crops** : Centre of Excellence in Millets, Athiyandal.
Finger millet, Foxtail millet, Kodo millet, Little millet, Barnyard millet and Proso millet

2. **Area, Production and productivity** :

Crop	Area (ha)*	Production (Tonnes)*	Productivity (kg/ha)*
Finger millet	104426	349628	3348
Foxtail millet	1057	518	470
Kodo millet	2646	5498	2075
Little millet	17401	25264	1452
Barnyard millet	6445	3643	559
Proso millet	100		

* Season and crop report of Tamil Nadu – Department of Economics and Statistics (2014-15)

3. **Total rainfall received during the year** : 143 mm
4. **Significant achievements of the center** : State variety release 2017 , Barnyard millet MDU1
5. **Research on Breeding (Crop-wise)** :

i) Plant genetic resources

S. No.	Crop	No. of germplasm				
		Maintained	Collected	Evaluated	Shared	Used in breeding
1.	Finger millet	2219	25	25	-	4
2.	Foxtail millet	795	12	50	21	10
3.	Kodo millet	181	20	20	20	-
4.	Little millet	151	6	50	14	8
5.	Barnyard millet	232	9	9	-	4
6.	Proso millet	412	1	50	5	5
	Total	3990	73	204	40	31

ii) Contribution of breeding materials in AICPR testing

S. No	Crop	Trial	Entries	Checks	2 nd Year testing	3 rd Year testing	Total
1.	Finger millet	IVT	TNEc1281	-	-	-	1
2.	Foxtail millet	FAVT	TNSi330 TNSi331	-	-	-	2
3.	Kodo millet	KAVT	TNPSc 176	TNAU 86	-	-	1
4.	Little millet	LAVT	TNPsu 171 TNPsu 174 TNPsu177	-	-	TNPsu171 TNPsu174	3
5.	Barnyard millet	BAVT	TNEf 197	-	-	-	1
6.	Proso millet	PAVT	TNPm231 TNPm234 TNPm238	TNAU145 TNAU151	-	TNPm228	4

iii) Development of breeding materials

a) Hybridization Programme

S. No	Crop	Number	Combination
1.	Finger millet	4	CO (Ra)14 x TNAU 28, CO (Ra)14 x Ms 387/2 CO 15 x TNAU 28, CO 15 x Ms 387/2
2.	Foxtail millet	10	SiA306 x TNSi351, SiA3156 x TNSi352 CO5 x TNSi355, CO(Te)7 x TNSi357 CO6 x TNSi359, SiA306 x TNSi360 SiA 3156 x TNSi362, CO5 x TNSi363 CO6 x TNSi368, CO(Te)7 x TNSi365
3	Little millet	8	BL6 x TNPsu 206, JK 8 x TNPsu208 OLM2503 x TNPsu211, CO(Samai)4 x TNPsu213 BL6 x TNPsu214, JK8 x TNPsu 217 OLM203 x TNPsu219, CO(Samai)4 x TNPsu221
4.	Barnyard millet	2	CO(KV)2 x TNEf 204, TNEf 204 x CO(KV)2
5	Proso millet	5	CO(PV)5 x TNPm255, TNAU145 x TNPm256 TNAU151 x TNPm259, TNAU164 x TNPm254 TNAU202 x TNPm260
	Total	31	

b) Segregating generations

S. No.	Crop	Crosses	Segregating generation	Homogenous Bulk Progenies
1.	Finger millet	CO (Ra) 14 x CO 13 CO 15 x CO (Ra) 14 CO (Ra) 14 x KMR 346 CO (Ra) 14 x TNEc 1269	F5 F5 F5 F5	6 3 5 2
2.	Foxtail millet	ISe375 x TNAU174 ISe1387 x AL1 ISe1773 x AL2 ISe1704 x TNAU174 TNAU174 x IC308966/2	F5 F5 F5 F5 F5	7 4 3 5 11
3	Little millet	CO2 x Kadiri1 CO2 x TNPsu 171 CO2 x BL 41-3 CO3 x Kadiri1 CO3 x TNPsu 171 CO3 x BL 41-3 CO (Samai)4 x BL 41-3, CO (Samai)4 x TNPsu 171	F5 F5 F5 F5 F5 F5 F5 F5	6 12 3 11 10 7 5 4
4	Barnyard millet	CO (KV) 2 x ACM 10-161 CO (KV) 2 x ACM 12-110 CO (KV) 2 x TNAU 185 CO (KV) 2 x TNAU 153	F5 F5 F5 F5	5 2 5 2
5	Proso millet	CO(PV)5 x DHPmV 2164 CO(PV)5 x TNPm 236 TNAU 164 x GPUP21 TNAU 164 x DHP2181	F5 F5 F5 F5	10 6 8 5
Grand Total				117

iv. Nucleus and breeder seed programme

S. No	Crop	Variety	Nucleus seed produced (kg)	Breeder Seed (kg)			
				2016		2017	
				Dispatched	Allotted	Khariff Produced	Rabi Being produced

1	Finger millet	CO(Ra)14	2.00	18	10	0.50	9.50
2	Finger millet	CO 15	2.00	66	95	49.00	46
3	Fox millet	CO (Te) 7	2.00	95	55	57.00	-
4	Kodo millet	CO 3	2.00	20	10	11.00	-
5	Little millet	CO (Samai)4	2.00	81	55	-	55
6	Barnyard millet	CO (KV) 2	3.00	191	200	28.50	171.5
7	Proso millet	CO (PV) 5	2.00	-	20	25.00	-

v) Registration of genetic stocks: Nil

vi) Co-ordinated trails: Three in Finger millet, two in little millet and one each in Foxtail/Barnyard/ Pros/Kodo millets.

vii) State Multi-Location trials

a) Finger millet: Totally five finger millet entries were evaluated at CEM, Athiyandal. Among the entries evaluated, the entry TNEc 1281 recorded the maximum grain yield of 1845.24 kg/ha followed by the check Paiyur 2 (1746.03 kg/ha).

b) Foxtail millet: The performance of two foxtail millet advanced cultures (TNSi330&TNSi331) along with the check, CO(Te)7 was evaluated in seven research centres. At Athiyandal, TNSi 331 gave higher grain yield of 2078 kg/ha which was observed as 6.2 percent increase over the check, CO(Te)7 (1975 kg/ha).

S. No	Entries	Plant height (cm)	Days of 50% flowering	No of productive tillers	Days of maturity	Yield(kg/ha)		Percentage of increasing over check
						Grain	Straw	
1.	TNSi330	117.0	60.4	2.4	90.2	1883	3844	-
2.	TNSi331	101.8	51.6	2.6	75.2	2078	3329	6.2
3.	CO(Te)7-check	83.0	53.4	2.8	80.2	1957	3708	-
	SEd	4.12	0.98	0.05	1.04	63.41	79.10	
	CD@5%	8.07	1.71	0.17	1.98	119.07	150.03	
	CV(%)	7.43	6.42	5.33	7.04	6.52	8.90	

c) Kodo millet: Totally four varagu entries were evaluated. Among the entries evaluated, the entry TNPSc 176 recorded the maximum grain yield of 1539.95 kg/ha followed by TNAU 86 (1403.49 kg/ha).

d) Little millet: Two little millet advanced cultures viz. TNPsu 176 and TNPsu176 and TNPsu177 were evaluated in seven locations of Tamil Nadu along with check variety CO(Samai)4. At CEM Athiyandal both the cultures performed better over the check and gave an average grain yield of 1583 and 1836 kg/ha which should 9.6 and 22.0 per cent increased yield over the check, CO(Samai)4 (1431 kg/ha) respectively.

S. No.	Entries	Plant height (cm)	Days to 50% flowering	No. of productive tiller	Duration days to maturity	Yield (kg/ha)		Percentage increase over check
						Grain	Straw	
1.	TNPsu 176	91.8	60.4	4.4	81	1583	3789	-
2.	TNPsu 177	90.4	61.4	3.6	83	1431	4152	9.6
3.	CO(Samai)4-check	78.4	63.4	3.2	87	1836	4624	22.2
	Mean	86.87	61.73	3.73	83.67	1616.67	4188.33	-
	SEd	3.17	1.02	0.48	1.59	52.0	60.3	-
	@5% CD	7.32	2.14	0.97	2.91	106.4	117.4	
	CV (%)	8.0	7.9	5.3	8.3	8.1	9.3	

e) Proso millet: Out of two advanced proso millet cultures (TNPm231 and TNPm238) tested in 7 locations across Tamil Nadu along with the state check, CO(PV)5, TNPm231 gave the highest grain yield of 1992 kg/ha which is 24.7 percent increased yield over the check, CO(PV)5 (1598 kg/ha).

S. No.	Entries	Plant height	Days of 50% flowering	No. of productive tillers	Days of maturity	Yield (kg/ha)		Percentage of increasing over the checks	
						Grain	Straw		
1.	TNPm231	63.8	44.6	4.8	69.9	1992	2338	24.7	-
2.	TNPm238	92.8	48.4	3.2	74.2	1774	2444	11.0	-
3.	CO(PV)5-check	90.4	46.4	3.4	71.2	1598	1982	-	-
	SEd	3.97	1.11	0.39	1.73	23.65	46.02		
	CD@5%	8.13	2.32	0.84	3.14	45.91	89.77		
	CV(%)	9.24	6.51	7.0	6.73	10.04	9.95		

viii. Station trials at the centre

1. Genetic improvement of finger millet, kodo millet and barnyard millet to evolve high yielding varieties suitable for rain fed conditions of Tamil Nadu.

Yield evaluation trials

A. Finger millet: Totally ten entries in PYT, ten entries in RRYT, thirteen entries in CYT and six entries in AYT along with the local check were evaluated. Statistical analysis is being carried out for further selection.

B. Barnyard millet: Totally four entries in RRYT and four entries in CYT are raised for evaluation. Biometrical observations are recorded and statistical analysis is being carried out for further selection.

b) Little millet comparative yield trial : Ten little millet entries were tested for their yield potential along with three checks. Among them. TNPSu 203 gave the highest grain (2480 kg/ha) and fodder (3619 kg/ha) yield over the best check BL6 (1921 and 3210 kg/ha of grain and fodder respectively) which was recorded as 36.3 and 29.1 percent increase over the checks CO(Samai)4 and BL6 respectively.

S. No.	Entries	Plant height (cm)	Days to 50% flowering	No. of productive tillers	Days of maturity	Yield (kg/ha)		percentage increase over the check	
						Grain	Straw	CO(Samai)4	BL6
1.	TNPSu201	92.4	64.3	6.2	85.1	2014	3213	10.9	4.8
2.	TNPSu202	89.3	65.7	7.3	86.4	2216	3482	22.0	15.4
3.	TNPSu203	78.5	63.0	8.1	88.0	2480	3619	36.6	29.1
4.	TNPSu 204	91.7	60.4	6.0	90.4	1997	3111	10.0	4.0
5.	TNPSu205	90.2	62.7	5.8	91.7	1814	3067	-	-
6.	TNPSu206	86.5	58.6	7.4	90.2	2079	3315	14.5	8.2
7.	TNPSu207	78.4	59.2	9.2	90.7	2145	3354	18.1	11.7
8.	TNPSu208	79.6	60.8	9.0	89.6	2016	3261	11.0	4.9
9.	TNPSu209	94.0	64.3	5.9	95.6	1948	3044	7.3	1.4
10.	TNPSu210	92.8	54.8	5.7	86.1	1999	3036	10.0	4.1
11.	CO(Samai)4-check	91.5	63.8	6.2	94.2	1816	2985	-	-
12.	JK8*	79.6	53.7	7.4	85.6	1619	2713	-	-
13.	BL6*	86.5	65.4	7.6	84.9	1921	3210	-	-
	Mean	87.0	61.3	7.1	89.1	2004.9	3185.4	-	-
	SEd	3.10	2.47	0.53	2.98	57.31	68.89		
	CD@5%	5.81	5.01	1.22	4.71	109.43	145.14		
	CV(%)	7.53	8.14	9.36	7.45	8.31	9.05		

c) Little millet preliminary yield trial: A preliminary yield trail was conducted during summer, 2016 involving ten advanced little millet cultures along with three checks. The culture, TNPSu203 gave the highest grain (2378 kg/ha) and straw (3419 kg/ha) yield which accounted for 35.6 and 30.3 percent increase ever CO (Samai)4 and BL6 respectively.

S. No.	Entries	Plant height (cm)	Days to 50% flower	No. of productive tillers	Days of maturity	Yield (kg/ha)		Percentage increase over the checks	
						Grain	Straw	CO (Samai)4	BL6
1.	TNPsu201	91.0	63.0	5.9	91.0	1998	2286	13.9	9.5
2.	TNPsu202	88.4	64.5	6.8	93.2	2192	3045	25.0	20.1
3.	TNPsu203	46.5	62.2	8.0	91.5	2378	3419	35.6	30.3
4.	TNPsu204	90.3	60.0	5.8	90.1	1828/	2036	4.2	0.2
5.	TNPsu205	89.4	61.4	7.2	91.5	1713	2022	-	-
6.	TNPsu206	85.1	57.5	9.0	88.4	1988	2091	13.3	8.9
7.	TNPsu207	76.9	58.4	8.5	88.7	2015	2425	14.9	10.4
8.	TNPsu208	78.5	59.7	5.5	90.0	2110	2788	20.3	15.6
9.	TNPsu209	93.4	63.2	5.2	94.4	1825	1987	2.9	-
10.	TNPsu210	91.2	52.9	6.0	83.0	1884	2036	7.4	3.2
11.	CO(Samai)4-check	78.1	62.4	7.1	92.1	1754	2110	-	-
12.	JK8*	85.3	52.6	7.0	81.5	1588	2014	-	-
13.	BL6*	85.3	64.7	7.3	93.4	1825	2027	-	-
	Mean	85.7	60.2	6.9	89.9	1929.1	2330.2	-	-
	SEd	2.14	2.58	0.67	2.54	54.32	58.47	-	-
	CD@5%	4.01	5.10	1.33	4.97	117.05	121.09	-	-
	CV(%)	7.19	6.97	7.03	8.19	9.14	10.52	-	-

Foxtail millet replicated raw yield trial: Ten foxtail millet cultures along with three checks (Co(Te)7, SiA3156) were evaluated for their yield performance. Among them six entries gave more than 10 percent grain yield increase over the checks. Hence, they could be fore wanted for preliminary yield trial further. However, the highest grain yield (2325 kg/ha) was recovered by the entry, TNSi354 followed by TNSi353 (2311 kg/ha).

S. No.	Entries	Plant height	Days of 50% flowering	No. of productive tillers	Days of maturity	Yield (Kg/ha)		Percentage of increasing over the checks	
						Grain	Straw	CO(Te)7	SiA3156
1.	TNSi351	89.3	50.6	3.4	84.3	2014	2352	8.0	-
2.	TNSi352	68.4	48.8	4.2	73.4	1774	1892	-	-
3.	TNSi353	92.5	52.7	2.8	88.0	3211	2575	14.7	14.7
4.	TNSi354	101.3	54.5	2.3	90.3	2325	2769	15.4	15.4
5.	TNSi355	97.4	53.2	3.0	89.7	2204	2443	9.4	9.4
6.	TNSi356	91.2	51.6	3.9	86.1	2300	2440	14.1	14.1
7.	TNSi357	92.8	53.5	2.9	88.8	2304	2517	14.3	14.3
8.	TNSi358	89.7	50.3	4.1	85.2	1958	2010	-	-
9.	TNSi359	88.4	79.7	4.0	83.8	2115	2320	5.0	5.0
10.	TNSi360	90.9	52.6	3.3	87.7	2228	2414	10.6	10.6
11.	CO(Te)7*	96.5	50.2	3.8	85.4	1998	2115	-	-
12.	SiA326*	87.6	48.6	3.5	83.7	1817	2006	-	-
13.	SiA3156*	97.3	54.1	2.4	89.4	2015	2340	-	-
	SEd	2.63	1.08	0.42	1.53	48.10	51.47		
	CD@5%	4.58	2.13	0.78	2.97	98.16	102.53		
	CVC%	8.17	9.51	5.42	9.94	10.06	11.51		

*Checks

Proso millet replicated raw yield trial (*Kharif* 2016): For yield evaluation, 10 proso millet entries were raised along with three checks. All the entries gave higher grain yield over the checks. However, TNPm252 out yielded over the which is 51.6 per cent increased grain yield over the check, CO (PV)5.

S. No	Entries	Plant height	Days of 50% flowering	No. of productive tillers	Days of maturity	Yield (Kg/ha)		Percentage of increasing over the checks	
						Grain	Straw	CO(PV)5	TNAU151
1.	TNPm251	72.3	40.5	6.4	66.3	2197	2745	51.2	44.0
2.	TNPm252	76.9	46.4	7.2	71.2	2203	2846	51.6	44.4
3.	TNPm253	82.5	45.9	5.4	70.0	2066	2319	42.2	35.4
4.	TNPm254	69.9	50.4	6.3	74.4	1997	2650	37.4	30.9
5.	TNPm255	73.7	51.2	5.6	75.8	2089	2233	43.8	36.9
6.	TNPm256	85.8	47.2	3.2	72.1	1544	1986	6.3	1.2
7.	TNPm257	61.9	41.4	4.9	67.5	2047	2495	40.9	34.1
8.	TNPm258	58.5	40.8	3.7	65.8	1610	1854	10.8	5.5
9.	TNPm259	67.3	43.2	3.8	68.5	1780	2010	22.5	16.6
10.	TNPm260	81.1	48.4	4.7	73.4	2013	2246	38.5	32.0
11.	CO(PV)5	80.5	46.6	3.9	71.9	1453	2001	-	-
12.	TNAU145-check	82.3	47.3	2.8	72.6	1328	1745	-	-
13.	TNAU151-check	60.4	42.1	4.5	71.3	1526	1897	-	-
	SEd	4.51	1.00	0.63	1.56	50.15	60.19		
	CD@5%	3.00	2.03	1.01	2.93	98.81	116.43		
	CV(%)	10.22	9.22	8.94	8.71	8.36	9.23		

2. Nucleus and breeder seed production in Finger millet, Samai, Varagu, Kudiraivali, Tenai and Panivaragu

Nucleus seed production: To maintain the genetic purity of latest high yielding varieties in small millets, ear to progeny rows were sown during 2016 for nucleus seed production. The bulked progeny rows were used for breeder seed production. The indented quantities of breeder seeds were produced and distributed during 2016 - 2017 to maintain the seed chain.

Seed multiplication of advanced cultures: The following 15 advanced cultures were raised during summer, 2017 in the farmer's field for yield evaluation and seed multiplication.

S.no.	Entries	Cultures
1.	Little millet	TNPsu181, TNPsu183, TNPsu184, TNPsu186, TNPsu189
2.	Foxtail millet	TNsi336, TNsi337, TNsi339, TNsi342, TNsi345
3.	Proso millet	TNPm242, TNPm244, TNPm245, TNPm247, TNPm248.

6. Significant Research highlights in other disciplines :

1. Agronomy

- Study on the evaluation of System of Finger millet Intensification in Tamil Nadu during *rabi* 2016, revealed that, raising finger millet nursery with 3 kg/ha and planted with spacing of 30 x 30 cm with 15 days old seedling recorded the highest grain yield of 2446 kg/ha and straw yield of 4414 kg/ha.
- Study on the effect of organic foliar spray on growth and yield of finger millet in Thiruvannamalai District was conducted during *rabi* 2016. The result revealed that basal application of 12.5 t/ha of Farm yard manure, *insitu* incorporation of sunnhemp on 45th DAS along with organic foliar spray of panchakavya 3 % on 45 DAS after planting of finger millet significantly recorded higher grain yield (2600 kg/ha) and straw yield (3799 kg/ha).

2. Plant Pathology

i. Assessment of finger millet blast incidence: Maximum leaf blast severity incidence was recorded from 16th September sown finger millet during 2016. The weather parameters were recorded and correlated with disease development. Present study indicated that decrease in temperature and increase in humidity favoured the disease development and caused epidemic of leaf blast.

ii. Screening of advanced culture: Screening of foxtail millet advanced cultures against leaf spot, rust and blast. Among the 63 lines TNSi 372, 373, 374, 389, 390, 396 and 397 were resistant to all the diseases.

iii. Assessment and management of seed borne pathogens in Finger millet: Premixture (mancozeb 63%+carbendazim 12%) of fungicide 3 g/kg of seed treatment with one spray of premixture of fungicide recorded less incidence of leaf blast followed by seed treatment with *Pseudomonas fluorescens* 10 g/kg of seed with one spray of premixture of fungicide managed the seed borne pathogens effectively.

7. CRP-AB trials, FLD's and TSPs :

Front Line Demonstration programme allotted and conducted: 45 ha

Tribal Sub-Plan programme allotted and conducted: 40 ha

8. Publications:

International

R. Sreeja, S. Balaji, L. Arul, A. Nirmalakumari, I.R. KannanBapu and A. Subramanian 2016. Association of lignin and flexible culm 1 (FC1) ortholog in impacting culm strength and lodging resistance in kodomillet (*Paspalum scrobiculatum* L.) Molecular Breeding, Nov. 2016: p1-9 (DOI 10.1007/s11032-016-05775)

Papers in seminars/conferences

Rajesh M., K. Prabakar and V. Valluvaparidasan. Eco-Friendly management of *Fusarium graminearum* on wheat seed. Department of Plant Pathology, Agricultural College and Research Institute, (TNAU), Madurai. pp 174&175.

Books

Jayachandran M., A. Nirmalakumari, M. Shanmugapriya and M. Rajesh. Recent technologies in Small Millets cultivation. (ISBN:978-93-84234-38-6)

Pamphlets

- i. Parasuraman, P., Nirmalakumari, A., Rajesh, M., Sivagamy, K and R. Kanchanarani. High yielding techniques for Finger millet.
- ii. Parasuraman, P., Nirmalakumari, A., Rajesh, M., Sivagamy, K and R. Kanchanarani. High yielding techniques for Little millet.
- iii. Parasuraman, P., Nirmalakumari, A., Rajesh, M., Sivagamy, K and R. Kanchanarani. High yielding techniques for Foxtail millet.
- iv. Parasuraman, P., Nirmalakumari, A., Rajesh, M., Sivagamy, K and R. Kanchanarani. High yielding techniques for Proso millet.

Awards

Dr. K. Sivagamy, Asst. Professor (Agronomy) awarded with Senior Women Educator and Scholar Award given by National Foundation for Entrepreneurship Development in 4th Women's Day Awards-2017 at Coimbatore.

9 Any other activities:

Breeding

- NADP - Mega seed project on " Quality seed production in Small Millets".
- DBT - Development of waxy and non waxy foxtail millet genotypes suitable for Assam and Tamil Nadu and preparation of value added food products – PI

Agronomy

Prasar Bharathi talk by Dr. K. Sivagamy, on Organic farming in millets on 27.04.2016, All India Radio, Chennai.

- Delivered guest lecture in cultivation aspects of small millets to ATMA farmers in Thiruvannamalai District.
- Delivered guest lecture in Small millets significance and its cultivation aspects at TANUVAS, Kattupakkam.

Plant Pathology

- Production of talc based bio-formulation of *Trichoderma viride* - PI in Venture Capital Scheme.

2. Almora

Mandate crops: Finger millet, Barnyard millet

Area. Production and productivity: In Uttarakhand hills, finger millet is grown in 112.8 thousand ha with a production of 155.7 thousand tonnes. Similarly, barnyard millet occupies an area of 63 thousand ha with production figures of 82.6 thousand tones. Uttarakhand has highest productivity (1311 kg/ha) of barnyard millet in India.

Total rainfall received during the year: During the crop season, we received 760 mm rainfall from June to November, 2016.

Significant achievements of the centre in brief during the year

- During the year, high yielding finger millet variety VL *Mandua* 348 was notified for cultivation in the state of Uttarakhand while two finger millet genotypes namely VL 376 in AICRIP and VL 367 in SVT were identified for release.

VL *Mandua* 348 (1877 kg/ha) out-yielded best check variety VL *Mandua* 324 (1676 kg/ha) by a margin of 12% in State Varietal Trials under organic condition. In farmers field trials also VL *Mandua* 348 showed an impressive gain of 19.27% over SVT mean yield of the variety and 38.72% over VL *Mandua* 324.

VL 376 an early duration (103-109 days), blast resistant high yielding genotype with mean grain yield of 2994 kg/ha. It has shown yield superiority of 15.73% over the early duration national check VL *Mandua* 352.

VL 367 recorded an average grain yield of 1304 kg/ha under organic conditions which was 8.93% higher than the best check VL *Mandua* 324 (1197 kg/ha).

Research on Breeding

- Germplasm maintained, collected, evaluated and use in breeding: At present, >2000 accessions of finger millet and 500 barnyard millet accessions are being maintained in the module. Nine new local finger millet collections from high hills of Pithoragarh district were added in the list of active collections during this year.
- Contribution of breeding materials in AICRP testing: In finger millet, two high yielding genotypes one each of brown (VL 387) and white grain (VL 503) were nominated for testing in All India Coordinated trials.
- Development of breeding materials including crossing programme, no of crosses/progenies in various segregating generations in tabular form

Finger millet

Generation	Crosses	Progenies grown	SPS
New crosses attempted	25		
F1 (true hybrids identified)	22		
F3	17	71	93
F4	38	372	237
F5	14	101	49
F6	7	107	38
F8	1	4	14

Barnyard millet

Generation	Crosses	Progenies grown	SPS
New crosses attempted	22		
F1 (true hybrids identified)	10		
F2	18		111

F3	19	97	113
F4	12	74	43
F5	13	190	89
F6	5	50	10
F7	11	108	8
F8	2		

iv. Nucleus and breeder seed programme

Crop	Variety	Breeder Seed		TL seed production
		DAC indent	Production	
Finger millet	VL 149	-	-	114
	VL 315	25.0	100.0	4.5
	VL 324	30.0	110.0	260
	VL 347	75.0	110.0	48
	VL 352	30.0	200.0	152
	Total	160.0	520.0	578.5
Barnyard millet	VL 172	-	-	25.0
	VL 207	88.0	15.0	3.5
	VL 181	-	-	1.5
	VL 29	-	-	12.5
	Total	88.0	15.0	42.5
Grand total		248.0	535.0	621

v. Registration of genetic stocks: A local collection from Uttarakhand hills viz., GPHCPB 45 was registered as genetic stock INGR16014 for high calcium with NBPGR, New Delhi

vi. Coordinated trials : Mention the allotted no and conducted

Trial name	Allotted	Conducted
Finger millet IVT	1	1
Finger millet AVT I&II	1	1
Barnyard millet AVT	1	1

vii. Multi-location Trials in your state

Finger millet State Varietal Trial (SVT): The trial comprising of ten entries including two checks was conducted under organic conditions. In State varietal trials , MH 905 (2919 kg/ha), MH 904 (2859 kg/ha), MH 906 (2800 kg/ha), MH 907 (2657 kg/ha) and MH 903 (2548 kg/ha) were top yielding entries.

Performance of various entries in Finger millet SVT 2016

Sl. No.	Entries	Grain yield (Kg/plot)					Grain yield (q/ha)	Rank
		R I	R II	R III	Total	Mean		
1	MH 901	0.485	0.720	0.580	1.785	0.595	17.63	
2	MH 902	0.830	0.715	0.640	2.185	0.728	21.58	
3	MH 903	0.615	0.965	1.000	2.580	0.860	25.48	5
4	MH 904	0.985	0.930	0.980	2.895	0.965	28.59	2
5	MH 905	0.930	1.075	0.950	2.955	0.985	29.19	1
6	MH 906	0.865	1.170	0.800	2.835	0.945	28.00	3
7	MH 907	0.765	0.995	0.930	2.690	0.897	26.57	4
8	MH 908	0.540	0.510	0.695	1.745	0.582	17.23	
9	MH 909	0.710	0.845	0.715	2.270	0.757	22.42	
10	MH 910	0.700	0.720	0.550	1.970	0.657	19.46	

Barnyard millet State Varietal Trial (SVT)

The trial comprised of twelve entries including two checks. The genotypes By 907 (1600 kg/ha), By 910 (1481 kg/ha), By 911 (1442 kg/ha) along with By 902 (1437 kg/ha) were statistically at par and superior to other entries in SVT.

Performance of various entries in Barnyard millet SVT 2016

Sl. No.	Entries	Grain yield (Kg/plot)					Grain yield (q/ha)	Rank
		R I	R II	R III	Total	Mean		
1	By 901	0.540	0.300	0.330	1.170	0.390	11.56	
2	By 902	0.660	0.430	0.365	1.455	0.485	14.37	4
3	By 903	0.265	0.260	0.295	0.820	0.273	8.10	
4	By 904	0.575	0.345	0.340	1.260	0.420	12.44	
5	By 905	0.490	0.580	0.285	1.355	0.452	13.38	6
6	By 906	0.405	0.330	0.240	0.975	0.325	9.63	
7	By 907	0.525	0.725	0.370	1.620	0.540	16.00	1
8	By 908	0.415	0.550	0.395	1.360	0.453	13.43	5
9	By 909	0.390	0.420	0.510	1.320	0.440	13.04	
10	By 910	0.360	0.520	0.620	1.500	0.500	14.81	2
11	By 911	0.500	0.380	0.580	1.460	0.487	14.42	3
12	By 912	0.240	0.425	0.315	0.980	0.327	9.68	

viii. Station trials at the centre

Finger millet Station Trial: In finger millet Station Trial, forty-one genotypes were evaluated against four check varieties VL 324, VL 347, GPU 45 and VL 352 in alpha lattice design. The genotypes VR 15-9 (4598 kg/ha), VR 16-6 (4590 kg/ha), VR 13-34 (4556 kg/ha) and VR 16-13 (4504 kg/ha) were superior to best check VL *Mandua* 324 (3581 kg/ha). Although all the white genotypes included in the trial were early in maturity, none of them was better than the checks.

Barnyard millet Station Trial: Thirty-seven entries were evaluated against three checks viz., VL 172, VL 207 and PRJ-1 in alpha lattice design. The genotypes VB 16-2 (3370 kg/ha), VB 16-5 (3230 kg/ha) and VB 16-16 (3089 kg/ha) were at par to the best check VL *Madira* 207 (3230 kg/ha).

Significant Research highlights in other disciplines (Agronomy/Pathology/Entomology) in brief (any new production technology, identification of resistant/tolerant lines for major diseases and insect-pests etc.)

Agronomy

One pre released short duration variety (VL 379) along with three checks (VR 708, GPU 45 and VL 352) were evaluated to different nutrient levels (50 per-cent NPK, 75 per-cent NPK, 100 per-cent NPK and 125 per-cent NPK) under rainfed conditions. The variety VL 379 recorded higher yield (4910 kg/ ha) as compare to all checks. The highest yield of VL 379 was recorded with 50 per-cent NPK (5121 kg/ ha) which is at par with other fertility levels. The highest cost benefit ratio (2.29) was found with VL 379.

Crop protection

In coordinated trials for finger millet blast screening AVT-I & II and IVT were conducted. In AVT I & II out of 5 entries, three entries namely GPU 45, VL 379 and VL 352 were found resistant for finger and neck blast disease. In IVT trial, 18 lines were screened out of which 4 lines were found resistant namely GPU 93, KOPN 942, KMR 630 and GPU 45. In barnyard millet trial (BAVT) nine entries were screened in which DHB 23-3 and DHBM 18-6 were found resistant. In SVT finger millet trial MH 901 and MH 909 were found resistant to neck and finger blast disease. Similarly in station trial for blast screening 45 entries of both white and brown colour types were screened and it was found that VR-16-12, VR-16-24, VR-16-25, VR-13-33 and VR-13-14

were highly resistant. In barnyard millet station trial for grain smut disease screening 40 entries were screened and 7 entries (VB-16-25, VB-16-26, VB-16-27, VB-16-28, VB-16-29, VB-16-31, VB-16-36 and VB-172) were found resistant.

CRP-AB trials, FLD's and TSPs (if allotted)-mention no of trials allotted and conducted

Trial	Allotted	Conducted
CRP AB	1	1
FLD Finger millet	10.0	9.88
FLD barnyard millet	5.0	4.98

Publications:

i. International

- Sharma, D., Jamra, G., Singh, U.M., Sood, S. and Kumar, A. 2017. Calcium Biofortification: Three Pronged Molecular Approaches for Dissecting Complex Trait of Calcium Nutrition in Finger Millet (*Eleusinecoracana*) for Devising Strategies of Enrichment of Food Crops. *Front. Plant Sci.* 7:2028. doi: 10.3389/fpls.2016.02028
- Sood, S., Khulbe, R.K. and Kant, L. 2016. Optimal Yield Related Attributes for High Grain Yield using Ontogeny Based Sequential Path Analysis in Barnyard Millet (*Echinochloa spp.*). *Journal of Agricultural Science and Technology* 18: 1933-1944.
- Sood, S., Kumar, A., Babu, B. K., Gaur, V. S., Pandey, D., Kant, L. and Pattanayak, A. (2016). Gene Discovery and Advances in Finger Millet [*Eleusinecoracana* (L.) Gaertn.] Genomics-An Important Nutri-Cereal of Future. *Frontiers Plant Sci.* 7, 1634. doi: 10.3389/fpls.2016.01634.
- Kumar, A., Metwal, M., Kaur, S., Gupta, A.K., Puranik, S., Singh, S., Singh, M., Gupta, S., Babu, B.K., Sood, S. and Yadav, R. 2016. Nutraceutical Value of Finger Millet [*Eleusinecoracana* (L.) Gaertn.], and Their Improvement Using Omics Approaches. *Front. Plant Sci.* 7:934. doi: 10.3389/fpls.2016.00934.
- Kumar, A. Sharma, D., Tiwari, A., Jaiswal, J.P., Singh, N.K. and Sood, S. 2016. Genotyping-by-Sequencing Analysis for Determining Population Structure of Finger Millet Germplasm of Diverse Origins. *The Plant Genome*. doi: 10.3835/plantgenome2015.07.0058.

ii. National

- Sood, S., Patro, T. S. S. K., Karad, S. and Sao, A. 2016. Stability of finger millet genotypes under diverse environments. *Indian Journal of Genetics & Plant Breeding* 76(3): 369-372.
- Sharma, A., Sood, S., Agrawal, P.K., Kant, L., Bhatt, J.C. and Pattanayak, A. 2016. Detection and assessment of nutraceuticals in methanolic extract of finger (*Eleusinecoracana*) and barnyard millet (*Echinochloafrumentacea*). *Asian Journal of Chemistry* 28(7): 1633-1637.
- Sood, S., Kant, L. and Pattanayak, A. 2017. Finger millet (*Eleusinecoracana* (L.) Gaertn.)-A minor crop for sustainable food and nutritional security. *Asian Journal of Chemistry* 29(4): 707-710.
- Sood, S., Patro, T. S. S. K., Karad, S. and Sao, A. 2016. Evaluation of finger millet genotypes for stability using parametric and non-parametric methods in India. *Electronic Journal of Plant Breeding* 7(4): 857-863.
- Sood, S., Patro, T. S. S. K., Karad, S. and Sao, A. 2016. Development and evaluation of early maturing white-grained finger millet (*Eleusinecoracana* L.) genotypes for cultivation in sub-mountain Himalayan region of India. *Electronic Journal of Plant Breeding* 7(4): 979-985.

iii. Papers in seminars/conferences

- Sood, S., Patro, T.S.S.K., Karad, S. and Sao, A. 2016. Graphical analysis of genotype by environment interaction of Finger millet grain yield in India. In: 1st International Agrobiodiversity Congress (IAC 2016), November 6-9, 2016 at New Delhi, India p 121.

Sood, S., Babu, B. K., Kant, L. and Pattanayak, A. 2016. Morphological and molecular characterization of Finger millet world collections-A climate resilient future crop. In: International Conference on Climate Change Adaptation and biodiversity: Ecological sustainability and resource management for livelihood security, 8-10 December, 2016 at CIARI, Portblair, India p 80.

iv. **Books/Book Chapters/Technical bulletins**

Sood, S. and Kalyana Babu, B. 2016. Finger Millet. In: Singh, M. and Kumar, S. (eds.) Broadening the Genetic Base of Grain Cereals, p 225-256., Springer, India.

v. **Brochures/pamphlets**

- Sood, S., Pandey, B. M., Chandrashekara, C. and Kant, L. 2016. *Parvatiya Kshetron mein manduakivigyanikkheti*. Extension leaflet 80/2016
- Sood, S., Pandey, B. M., Chandrashekara, C., Roy, M. L. and Kant, L. 2016. *Parvatiya Kshetron mein Madirakivigyanikkheti*. Extension leaflet 81/2016
- Sood, S., Pandey, B. M., Chandrashekara, C., Stanley, J., Roy, M. L. and Kant, L. 2016. *Uttarakhand ke parvatiyaksetromein ramdanakibharpoorupajhetu vegyanikkheti*. Extension leaflet 82/2016
- Gupta, A., Saha, S., Sood, S. and Kant, L. 2016. *Manduake postik biscuit*. Extension leaflet 83/2016.

Awards

Dr. Salej Sood got "Boshi Sen Scientific Appreciation award from DG, ICAR on Institute foundation day 4th July, 2016 at ICAR-VPKAS, Almora.

3. Berhampur

1. **Name of the centre** : AICRP on small Millets, Berhampur, Odisha
Mandate crops : Finger millet and Little millet
2. **Area** (in '000 ha): The area under finger millet has been declined from 196.01 in 2001-02 to 172.99 (2012-13) and 162.10(2013-14) whereas in small millets (other than finger millet) the area has been declined from 42.36(2001-02) to 15.69(2010-11), but it is now increasing slowly from 15.69 in 2010-11 to 19.32 in 2013-14.
Production (in '000 MTs) : The total production of finger millet increased from 144.59 (2001-02) to 173.86(2009-10) but declined to 140.05 in 2013-14. In small millets (other than finger millet) the production has also been declined 20.12(2001-02) to 8.86 (2012-13), but the production increased to 9.70(2013-14) as compared to 2012-13.
Productivity (in Kg/ha) : In Finger millet the productivity has been increased from 683 (2002-03) to 864 (2013-14) whereas in small millets (other than finger millet) the productivity also increased from 306 (2002-03) to 502 (2013-14). The increase in productivity has resulted due to development of new high yielding varieties.
3. **Total rainfall received during year 2016-17**: A total of 881.25 mm rainfall, 82 rainy days.
4. **Significant achievements of the centre during 2016-17** :
 - i. **Information on variety release-**
 - (a) **OEB 526(ARJUNA)** variety of **Finger Millet** has been released in national level.
 - National Identity No.-IC 598846
 - Parentage- SDFM 30 x PE 244
 - Medium maturity (106 days), semi compact ear head, light brown grain colour.
 - Average grain yield of 26.00 quintals/ha.
 - Moderately resistant to leaf, neck and finger blast diseases.
 - It can tolerate dry spell of 10-12 days at vegetative and 6-8 days at reproductive stages
 - Area of adaptation- Odisha, Bihar, Chattishgarh, Karnataka, Tamil Nadu
 - (b) **OEB 532(KALUA)** of **Finger Millet** has been released in Odisha state.
 - National Identity No.- IC 598847
 - Parentage : GPU 26 x L 5
 - Semi dwarf, medium maturity (110 days), Semi compact, medium to long ear size.
 - Grains are light brown in colour.
 - Yield- average yield of 17.62q/ha and potential yield 50.86 q/ha
 - It is resistant to leaf and neck blast and mod. Resistant to finger blast, Highly resistant myllocerus weevil, earhead caterpillar and stem borer and resistant to grass hopper.
 - Tolerate dry spell 8-10 days at vegetative and 5-6 days at reproductive stages.
 - Areas of adaptation- Odisha and Chhatisgarh
 - ii. Any major production technology developed and recommended at National or State level

Research on Breeding :

Crop	No. of germplasms maintained	No. of germplasms collected	No. of germplasms evaluated	No. of germplasms used in breeding
Finger millet	125	Collected -10 nos Request made to IIMR- 11 nos	125(duration : <100days-19 nos, 100-120days -91nos, >120 days-15 nos; Height: <100cm- 93nos, 100-120cm – 28 nos, >120cm-4nos)	5 lines to be used in station trial kharif 2017
Little millet	191	Request made to IIMR- 25 nos	191(duration : 80-90days-120 nos, 90-100days -59nos, >100 days-12 nos; Height: <100cm- 11nos, 100-120cm – 101 nos, >120cm-79 nos)	-

iii. Contribution of breeding materials in AICRP testing- nil

iv. Development of breeding materials including no. of crossing programme, no. of crosses/progenies in various segregating generations: A total of 36 F7 lines (Bulk) developed from F6 single plants from 4 crosses and kept for initial evaluation trial during 2017-18. The crosses are:

1. GPU 28(ms) x Bhairabi
2. GPU 28(ms) x Chilika
3. GPU 28(ms) x OEB 526

v. Nucleus and Breeder seed production programme at CPR, Berhampur during 2016-17

Crop	Variety	Area sown(ha)	DAC indent(q)	Expected Production (q)	Stage of crop
Nucleus seed production					
Finger millet	Arjuna (OEB 526)	0.025	-	0.30	Flowering stage
-do-	Kalua (OEB 532)	0.025	-	0.30	Flowering stage
	Total	0.050		0.60	
Breeder seed production					
Finger millet	Bhairabi (BM 9-1)	0.40	1.00	5.00	Flowering stage
-do-	Chilika (OEB 10)	0.20	1.00	2.00	Flowering stage
-do-	Suvra (OUAT 2)	0.10	1.00	1.00	Flowering stage
	Total	0.70	3.00	8.00	

- vi. Registration of genetic stocks- The application for registration of finger millet variety ARJUNA(OEB 526) to be made shortly.
- vii. Coordinated trials: Nos. allotted -3 (Finger millet- IVT, AVT I & II, Little millet-LAVT)
Nos. conducted- 3 (Finger millet- IVT, AVT I & II, Little millet-LAVT)
- viii. Multi-location trials – Finger millet varieties Arjuna(OEB 526) and Kalua (OEB 532) along with check variety Bhairabi has been tested under OFT in 4 locations in Odisha. The variety Arjuna(OEB 526) and Kalua(OEB 532) had yield advantage of 12% and 8%, respectively over check variety Bhairabi.
- ix. In a station trial of Finger Millet, two entries (BM-3-1 and T-25-1A) out yielded about 12% over check variety Bhairabi and will be submitted for inclusion in Initial Varietal trial(IVT).
In a station trial of Little Millet, two entries (OLM 217(S) and OLM 233(S)) both has an yield advantage of about 20 % over national check variety OLM and will be submitted for inclusion in Little Millet Advanced Varietal trial (LAVT).

5. Significant Research Highlights in other disciplines :

Agonomy: Cordinated trials allotted- 8, Trials conducted-5

- a. In 4 years of trial "Conservation farming and its effects on growth and yield of little millet" among tillage methods, summer ploughing (1 ploughings with MB plough + secondary tillage) recorded the highest grain and straw yield, net return and B:C ratio. Among cultural practices opening conservation furrow after every 6-8 rows, mulching with crop residues, weedicide application(isoproturon @ 0.5 kg a.i /ha), rotation with legumes- 2 year rotation significantly recorded the highest grain, straw yield, net return and B:C ratio, closely followed by intercropping of red gram with finger millet and opening conservation furrow between paired rows of pigeon pea.
- b. In 4 years of trial "Conservation farming and its effects on growth and yield of finger millet" conservation/minimum tillage (2 ploughings with MB plough + secondary tillage however recorded the highest grain and straw yield closely followed by summer ploughing (1 ploughings with MB plough + secondary tillage). Among cultural practices opening conservation furrow after every 6-8 rows, mulching with crop residues, weedicide application (isoproturon @ 0.5 kg a.i /ha), rotation with legumes- 2 year

rotation significantly recorded the highest grain, straw yield, net return and B:C ratio, closely followed by intercropping of red gram with finger millet (2:8) and opening conservation furrow between paired rows of pigeon pea.

c. In 3 years of trial "Sequence cropping studies in little millet" little millet followed by guar significantly recorded the highest little millet grain equivalent yield, net return and B:C ratio.

Entomology: Cordinated trials allotted- 11, Trials conducted- Kharif -9, Summer -2 (Continuing)

- In case of Finger millet Initial Varietal Trial (18+2 entries), IVT-16(PR10-35) showed immune response against insect pests (grass hopper and aphids) whereas IVT-3(VR708) found to be resistant against the insect pests. Two entries IVT-13 & IVT-11 found to be tolerant in reaction against insect pests of finger millet.
- In case of Finger millet Advanced Varietal Trial (5+2 entries), AVT-4 (VL 379) found to be resistant against grass hopper and aphids.
- In case of Little millet Advanced Varietal Trial (14+1 entries), none of the entries were found to be resistant against shoot fly.
- In case of integrated management of little millet shoot fly, Spraying with NSKE 5% at 15 DAS found to be the best treatment against shoot fly followed by spraying of 1500 ppm neem at 15 DAS.

Pathology: Cordinated trials allotted- 5, Trials conducted- Kharif -5

Identification of Resistant/Tolerant lines for major diseases

- Entries like GPU 67*, VR 1094, VR 14-3, VL 352, KOPM 942 & PR 202 were found to be immune and only two entries i.e. VR 936* & DHFM 78-33 showed highly resistance to foot rot disease of finger millet.
- Finger millet Advanced Varietal Trial: Out of 5 entries, none of the entries were found to be resistant to blast and brown spot disease, where as only GPU 45* entry showed highly resistance to foot rot disease..
- Little Millet Advanced Varietal Trial: Out of 14 entries, entries like TNPSU 174, RLM 238, OLM 203*, KOPLM 53, GPUL 2, WV 126, 5K*, DLM 95, DHLT 28-4 (DHLM 28-4), GPUL 3 & TNPSU 171 showed resistance to sheath blight disease.

6. CRP-AB trials, FLD's and TSP's (if allotted)

FLD- Not allotted for the year 2016-17

TSP- TSP programme has been proposed for supplying critical inputs, implements and skill building training by revalidating the spill over amount of Rs 2, 37,600.00 by the end of financial year 2016-17.

7. Publications :

Papers in Seminars/Conferences :

- a. Mishra, I.O.P.; Mohapatra, P.M.; Kar, A.; Bal, S.S., 2016. Seasonal incidence and Integrated Management of Shoot fly (*Atherigona pulla* (W.)) in Little millet. Paper presented in National Symposium on New horizons in Pest Management for Sustainable Developmental Goals 24th – 25th November 2016.
- b. Mohapatra PM, Prusti AM, Pradhan K, Mishra IOP, Panigrahi RK and Panda PK. Significance of Finger Millet for food and nutritional security. Poster presentation in National Seminar on Biotechnology for Sustainable Utilisation of Bioresources (BSUB) held at Department of Biotechnology, North Orissa University, Takatpur, Baripada, Odisha 17-19 February 2017.

Books/Technical bulletins/Articles :

- a. Mohapatra, P. M., Mishra Ipsita O. P., Panigrahi R. and Panda, P. K. An Article entitled "Mandia Bihan Utpadana Padhati". *Chasira Sansar* – A Monthly Odiya magazine published from Directorate of Extension, OUAT, Bhubaneswar, No 33, 2016, Pp 13-16.

ii. **Brochures/Pamphlets :**

iii. **Awards (if any) :**

8. Any other activities :

- a. TV talk on 'Nursery management of summer finger millet' broadcasted in Annadata programme on 14.01.2017 in ETV Sambad Odia Channel at 6.30-7.00 AM.
- b. TV talk on 'Transplanting of summer finger millet in main field and after care' broadcasted in Annadata programme on 02.02.2017 in ETV Sambad Odia Channel at 6.30-7.00 AM.

4. Dindori

Name of centre: AICRP on Small Millets, JNKVV,RARS,Dindori (MP)

Mandate crops : Kodo millet and Little millet

Area, Production and productivity: Madhya Pradesh has the largest area under kodo millet (143.43 thousand ha) followed by little millet (51.54 thousand ha) and barnyard millet (11.76 thousand ha). Other small millets namely finger millet and foxtail millet are grown in 0.34 thousand ha and 0.13 thousand ha, respectively. Productivity of kodo millet and little millet was reported 524 kg/ha followed by 423 kg/ha in finger millet, 298 kg/ha in barnyard millet and 260 kg/ha in foxtail millet during 2013-14

Total rainfall: 1430 mm from 01.06.2016 to 28.02.2017

Significant achievement: One variety of little millet DLM-103 has been sent to SVRC for rainfed areas of M.P

Any major production technology developed: Application of INM (5 t FYM + 1 t VC + 500kg/ha along with inorganic RDF,40:20:10 NPK kg/ha) would be better choice for obtaining higher grain yield of kodo millet under skeletal soil condition of Dindori district in MP

Research on Breeding (Crop-wise)

Germplasm maintained, collected, evaluated and use in breeding

Germplasm maintained,			
Crop.	Germ Plasm collection	Evaluation	Use in Breeding Trial
KM	50	50	11
LM	50	50	9

Contribution of breeding materials in AICRP testing

Crop	No.	Name
Kodo millet	01	DPS- 118
Little millet	01	DLM- 95

Development of breeding materials including crossing programme, no of crosses/progenies in various segregating generations

Mutation Breeding in Kodo millet :The seeds of JK-41 exposed to 55, 65, 75 85 and 95 kvp . In M-1 , 65 kvp only one plant was selected . while 55 kvp unit resulted identical progenies to parents and 75 to 95 kvp effected progenies to lethal. In M2, as selected from 65 kvp among progenies only one plant was found different from parent.The seeds of selected plant was sown in progeny rows . All plants were uniform in characters with 10 to 16 tillers/plant having quite thick, long panicle about 9 -10cm. The seeds of M 3 will be used in further research in Station Varietal Trials.

Nucleus and Breeder seed programme

Nucleus Seed:Four kodo millet varieties JK-439,JK-41,DPS 9-1,JK-48 and one little millet variety JK-8 were maintained by SP selection grown in progeny rows.

Crop	Variety	Qty produced (kg)
Kodo millet	JK-439	6kg
	JK-41	8kg
	DPS9 -1	6kg
	JK-48	2kg
Little millet	JK-8	2kg

Breeder Seed:-

Crop	Varieties	Qty Produced (q)
Kodo millet	JK-48	4.20
	JK-439	2.70
	JK-41	5.60
Little millet	JK-8	4.30

Coordinated trials : Allotted : 05 Conducted : 03*

Performance of kodo millet cultures in Advance Station Varietal Trial (KSVT)

S.No.	Entries	Plant height (cm)	No. of Productive Tillers/plant	Panicle Length (cm)	Days to 50% Flowering	Days to Maturity	Grain Yield (q/ha)
1	SVT-1	43.43	6.83	6.83	69.00	95.67	21.56
2	SVT-2	39.00	6.67	7.10	71.00	92.67	22.17
3	SVT-3	45.33	8.67	6.43	64.67	94.33	25.15
4	SVT-4	53.73	9.67	6.20	71.33	90.67	24.76
5	SVT-5	47.00	8.10	6.50	68.00	90.00	27.05
6	SVT-6	45.57	7.47	7.03	62.00	91.67	25.53
7	SVT-7	48.30	7.37	6.60	62.33	95.00	25.15
8	SVT-8	43.20	7.90	6.20	66.33	92.67	24.00
9	SVT-9	46.93	7.07	6.53	60.67	91.33	27.43
10	SVT-10	55.00	7.90	7.03	66.33	92.00	28.19

In kodo millet station trial, nine entries along with one check (JK-48) were tested. Amongst them, entry no. SVT-10 (Check) recorded the highest grain yield (28.19q q/ha), followed by SVT-9(27.43 q/ha).

Germplasm collection, maintenance, characterization and evaluation. Small millets germplasm were collected from the remote areas of Dindori district of Madhya Pradesh. Collected germplasm were characterized and evaluated for important morphological and yield related characters.

Kodo millet

Entries	No. of tillers	Height (cm)	Panicle length (cm)	Yield q/ha	Entries	No. of tillers	Height (cm)	Panicle length (cm)	Yield q/ha
1	5.6	43.6	5.3	9.0	26	6.0	48.3	6.0	9.3
2	6.3	44.6	6.6	9.0	27	7.0	51.6	6.6	6.5
3	7.6	48.6	6.6	7.0	28	6.6	51.6	7.0	10.0
4	6.0	42.3	6.0	10.0	29	7.3	42.0	6.3	11.0
5	7.0	44.0	6.0	5.0	30	6.6	47.6	6.6	9.0
6	6.0	44.3	6.6	5.0	31	7.0	52.0	7.0	9.5
7	7.3	46.0	7.0	7.5	32	6.3	47.3	6.6	8.0
8	6.6	40.0	7.3	7.0	33	5.6	44.3	6.6	17.0
9	6.0	40.3	6.6	8.6	34	5.3	48.0	6.3	17.0
10	6.0	42.6	7.3	8.0	35	6.6	44.3	7.0	9.4
11	7.0	39.0	6.3	8.8	36	7.0	40.0	6.3	10.0
12	5.3	38.3	6.6	10.0	37	6.6	38.0	6.6	11.0

13	7.3	44.0	6.6	7.9	38	5.6	45.6	6.3	9.6
14	6.6	42.6	6.3	7.0	39	8.0	52.0	6.6	10.0
15	6.3	41.0	7.0	9.0	40	8.3	54.0	6.6	24.0
16	6.6	45.0	7.3	15.0	41	7.6	50.0	7.6	12.0
17	6.6	46.0	7.0	10.0	42	6.6	55.0	7.0	12.0
18	7.0	45.6	6.6	9.5	43	7.3	55.6	7.3	25.0
19	6.3	45.3	6.6	10.6	44	6.6	49.3	6.6	20.0
20	6.0	46.0	6.6	13.4	45	7.0	49.6	6.3	11.0
21	6.3	50.0	7.0	10.0	46	6.3	53.0	6.3	12.0
22	7.3	50.6	7.3	21.0	47	7.3	55.0	7.0	11.5
23	7.6	49.6	6.3	18.0	48	7.3	53.6	6.3	14.6
24	7.3	50.0	7.0	12.4	49	7.3	54.3	7.6	13.7
25	7.0	51.0	6.3	11.5	50	7.0	56.0	7.3	11.0

Result —Grain yield varied from 5.0q/ha to 25.0 q/ha among the tested genotypes. KM 43 recorded the highest grain yield 25.0q/ha followed by KM 40(24.0q/ha), KM-22(21.0q/ha), and KM-40 (20.0q/ha).These lines matures within 100 to 110 days and appeared promising for further evaluation.

Little millet

Entries	No. of tillers	Height (cm)	Panicle length (cm)	Yield q/ha	Entries	No. of tillers	Height (cm)	Panicle length(cm)	Yield q/ha
1	6.2	57.0	14.75	4.5	26	5.0	58.0	23.0	8.0
2	5.6	57.4	20.4	8.0	27	5.8	57.5	21.5	7.9
3	6.0	58.5	17.2	7.0	28	4.2	64.6	24.6	9.0
4	5.8	60.5	18.6	5.0	29	4.4	64.6	17.4	8.6
5	5.2	48.6	19.6	6.5	30	3.6	55.4	17.25	7.5
6	6.0	55.2	18.2	5.8	31	4.8	63.8	28.4	6.0
7	6.0	51.6	22.0	6.0	32	4.2	59.0	15.8	7.0
8	5.8	57.2	18.6	9.6	33	2.8	66.0	22.0	9.7
9	5.0	55.2	16.4	9.0	34	3.0	53.0	16.3	6.0
10	5.8	59.0	15.6	11.0	35	3.8	66.2	25.6	9.0
11	5.5	59.4	19.0	9.8	36	3.0	60.0	18.0	4.0
12	4.8	54.4	16.0	9.0	37	5.4	62.0	17.6	8.0
13	5.0	53.6	19.6	7.8	38	5.0	55.0	18.6	5.8
14	5.8	58.8	19.2	8.0	39	4.6	61.8	20.6	8.6
15	6.0	60.2	19.5	5.7	40	3.6	66.6	18.3	7.8
16	6.6	58.0	28.6	6.8	41	3.8	62.4	21.4	9.0
17	6.0	56.4	18.6	8.0	42	5.0	59.7	21.0	7.8
18	6.2	68.0	17.0	7.7	43	4.8	59.0	17.5	8.8
19	4.6	58.8	16.0	8.0	44	3.4	58.4	18.2	5.8
20	4.0	55.4	18.2	10.0	45	2.8	60.0	18.4	6.8
21	4.8	59.4	21.4	6.9	46	2.8	58.6	22.0	9.0
22	3.6	69.0	23.4	5.7	47	2.8	58.0	16.2	8.0
23	5.0	67.5	22.6	8.0	48	3.2	60.0	16.0	7.7
24	4.4	60.4	22.6	7.8	49	3.0	58.0	19.0	7.7
25	4.4	68.4	25.6	6.6	50	3.6	58.6	18.8	8.6

Result—Grain yield ranged from 4.5q/ha to 11.0 q/ha. Highest grain yield was recorded in DLM-10 (11.0q/ha) followed by DLM—20 (10q/ha),DLM-11(9.8q/ha), DLM—33 (9.7q/ha), and DLM—8 (9.6q/ha).

Significant Research highlights in other disciplines: Agronomy

Organic farming research in Kodo Millets - A comparative study

S.NO.	Treatments	Grain Yield (kg/ha)	Straw Yield (kg/ha)	GMR (Rs/ha)	COC (Rs/ha)	NMR (Rs/ha)	B:C Ratio
1	Only organics (FYM 5.0 ton/ha + VM 1 ton/ha + Neem cake 500 kg/ha)	1260	1430	32930	27000/-	5930/-	1.22
2	Inorganic (RDF NPK only)	1330	1680	34930	20000/-	14930/-	1.75
3	INM (RDF + NPK)	1640	2060	43060	31000/-	12060/-	1.39

Result:-To develop production package for organic kodo millet a trial was conducted to study the efficacy of various sources of organic manures,(FYM, Vermi Compost and Neem cake) with and without inorganic RDF (40:20:10 NPK kg/ha) in enhancing productivity of kodo millet .It is revealed from the Table that the Integrated Nutrient Management (INM) gave highest grain yield (1640 kg/ha),straw yield (2060 kg/ha) and GMR (Rs 43060/ha)as compared to other treatments. However, NMR and B:C ratio indicated that application of inorganic RDF (40:20:10 NPK kg/ha) was a better choice and gave hiher net returns (Rs 12060/ha) and B:C ratio (1.75) under skeletal soil condition of Dindori district in MP

Publications: Brochures/pamphlets : 04

Exhibits of small millets were displayed in the farmers day, lectures were delivered in different training programmes.

5. Dholi

Mandate crops are Finger millet and Proso millet. Experiments are being also conducted on Foxtail and Barnyard Millets.

Area, Production and Productivity :

Sl. No.	Crop	Area in 000 ha	Production 000 tons	Productivity (Kg/ha)
1.	Finger Millet	8.0	9.0	1180
2.	Other Small Millets	3.0	2.0	764

Total rainfall received during the Kharif, 2016: 645 mm

Significant achievements of the centre in brief during the year-2016

One variety of Foxtail Millet, Rajendra Kauni-1 has been released and notified by CVRC (No. 3-52/2016-SD.IV). Characteristics of Rajendra Kauni-1: Erect, light green colour leaves, medium lobe, brown colour, panicle brown awns with medium attitude, plant height ranges from 122 cm to 140 cm with average 132 cm, it flowers in 47 days and matures in 81 days. It possesses high degree of resistance against leaf blast, rust, smut, brown spot, downy mildew and leaf blight. Its average yield is 24.5 q/ha.

Research on Breeding

- ix. Germplasm maintained, collected, evaluated and use in breeding

Sl. No	Crop	No. of Germplasm Evaluated & Maintained
1	Finger millet	177
2	Foxtail Millet	50
3	Proso Millet	280

- x. Contribution of breeding materials in AICRP testing: Two genotypes of Finger Millet and One genotype of Proso Millet will be nominated in Annual Group Meeting-2017
- xi. Development of breeding materials including crossing programme, no of crosses/progenies in various segregating generations in tabular form
20 crosses were harvested in four combinations

Sl. No.	Crops	Generation	No. of Plants
1	Finger Millet	F ₃	78
2	Finger millet	F ₄	60
3	Finger millet	F ₅	44
4	Finger Millet	F ₆	32

- i. Nucleus and breeder seed programme

Sl. No.	Crop	Nucleus Seed	Breeder Seed
1	Finger Millet	10 Kg	5.0 Q.
2	Foxtail Millet	10 Kg	0.5 Q.
3	Proso Millet	10 Kg	0.5 Q.

- ii. Registration of genetic stocks
 iii. Coordinated trials : Mention the allotted no and conducted

Sl.	Crop	Allotted	Conducted
1	Finger Millet	02	02
2	Foxtail Millet	01	01
3	Proso Millet	01	01

- iv. Station trials at the centre: Finger Millet

Sl. No.	Entries	Yield q/ha
1	RAUF-1	37.04
2	RAUF-2	38.89
3	RAUF-3	48.51
4	RAUF-4	44.45
5	RAUF-5	48.51
6	RAUF-6	40.74
7	RAUF-7	35.19
8	RAUF-8	37.04
9	RAUF-9	38.89
	CD @ 5%	5.37
	CV%	7.65

In station trial of Finger millet, among nine genotypes, three genotypes namely, RAUF-14(44.45q/ha), RAUF-13 (48.51q/ha) and RAUF-15 (48.51q/ha) were significantly superior than local control (38.89q/ha)

Foxtail Millet

Sl. No.	Entries	Yield q/ha
1	RAUFO-1	20.37
2	RAUFO-2	25.93
3	RAUFO-3	25.93
4	RAUFO-4	18.52
5	RAUFO-5	27.78
6	RAUFO-6	24.08
7	RAUFO-7	31.48
8	Rajendra Kauni-1	25.93
	CD @ 5%	4.25
	CV %	9.57

In station trial of Foxtail millet, out of eight genotypes, only one genotype, RAUFO-7 (31.48 q/ha) was significantly superior than local control (25.93q/ha).

Publications:

International- NA

National –

- 1- **S. K. Singh** and S. K. Varshney, 2016, Genetic Variability for morpho-agronomic traits. *Advances in Life Sciences*, 5 (17), 7000-7004
- 2- Saundrya Kumari and **Satish Kumar Singh**, 2016, Correlation and path coefficient analysis for yield and its yield attributes in promising finger millet {*Eleusine coracana* (L.) Gaertn.} genotypes. *The Bioscan*, 11 (2), 1079-1082.
- 3- Satish Kumar Singh, S. K. Varshney and Chandan Kumar. (2016). Genetic divergence for agro-morphological traits in foxtail millet (*Setaria italica* (L.) Beauv.). *The Bioscan*, Accepted.

Papers in seminars/conferences :

S. K. Singh and S. K. Varshney Assessment of interrelationships between yield and yield components in foxtail millet {*Setaria italica* (L) Beauv.} genotypes" in XIII Agricultural Science Congress 2017.

6. Guntur

Research on Breeding (Crop-wise):

At this centre breeding experiments are initiated in sorghm, ragi, foxtail millat and proso millet during 2015-16 after a break of almost ten years due to lack of scientist in the millets scheme. Later University directed to concentrate research only on Foxtail millet and Proso millet.

Foxtail Millet Advanced Trial: Thirteen entries including local check were evaluated for different traits and found that there is significant difference among the test genotypes. Out 12 entries nine were found on par with the check but none of them were significantly superior over the check. The average yield of the entries is 1968 kg/ha.

Proso Millet Advanced Trial: Eleven entries including local check were evaluated for different traits and found that there is significant difference among the test genotypes. Out 11 entries three entries viz., PAVT 10, PAVT 8 and PAVT 2 were found to be significantly superior to the check. The average yield of the entries is 2295 kg/ha.

Further, Segregating material of different generations of both Foxtail millet and Proso millet were obtained from Center for Excellence in Millets, Athiyandal, Tamil Nadu and RARS, Nandyal were studied, single plant selections were made and advanced to next generation. The details are presented below:

a. Selections done in F₃ populations (Foxtail millet)

S. No.	F ₃ Populations	No. of individual plants selected
1	SIA - 3088 x lsc -1204	3
2	SIA - 3088 x lsc - 1541	5
3	SIA - 3088 x lsc - 376	9

b. Selections done in F₄ populations (Foxtail millet)

S. No.	F ₄ Populations	No. of individual plants selected
1.	ISe 375 x TNAU 174/3/9/12	6
2.	ISe 1387 x AL 1/6/16/21	7
3.	ISe/1773 x AL 2/24/8/10	12

c. Selections done in F₅ populations (Foxtail millet)

S. No.	F ₅ Populations	No. of individual plants selected
1.	ISe/1704 x TNAU 174/16/9/11	5
2.	TNAU 174 x lc 308966/2/17/8/20	5

a. Selections done in F₄ populations during *Rabi*, 2016-17 (Proso millet)

S. No.	F ₄ Populations	No. of individual plants selected
1.	CO(PV)5 x DHP _r MV 2164/12/8/23	8
2.	CO(PV)5 x TNP _m 236/5/27/33	6

b. Selections done in F₅ populations during *Kharif* 2016-17(Proso millet)

S. No.	F ₅ Populations	No. of individual plants selected
1.	TNAU 164 x GPUP 2181/4/15/19	5
2.	TNAU 164 x DHP 2181/18/36/14	6

7. Hagari

Name Mandate crops: Foxtail millet & Ragi

Area. Production and productivity: Foxtail millet occupies an area of 8628 hectare, production of 1035 tones and productivity 396 kg in six districts of Hyderabad Karnataka. Ragi grown in Ballari district in an area of 3580ha and production of 2472 tones with productivity of 727 kg

Total rainfall received during the year: 241.7mm

Significant achievements of the centre in brief during the year:

Promising high yielding Foxtail Millet Genotypes H-46 is was developed from this centre

Research on Breeding (Crop-wise)

- xii. Germplasm maintained, collected, evaluated and use in breeding

Crop	Accessions
Foxtail millet	80
Ragi	550

- xiii. Development of breeding materials including crossing programme, no of crosses/progenies in various segregating generations in tabular form

Crosses	Generation	Population Size
Sia 3156 X Sia2849	F3	289
Sia2859 X Sia2846	F3	256
Sia2846 x Sia2854	F3	350
Ise 43K x Sia 2644	F3	429
Sia 2849 x Sia 2859	F3	158
Sia 2845 x Sia 2855	F3	350

- xiv. Coordinated trials : Mention the allotted no and conducted

SI No.	Crop	Allotted. Trials	No.
1	Ragi	Finger Millet Initial varietal Trials	1
2		Finger Millet Advanced varietal Trials	1
3	Foxtail millet	Foxtail millet Advanced varietal Trials	1
4	Little millet	Little millet Advanced varietal Trials	1
5	Prosomillet	Proso millet Advanced varietal Trials	1

xv. Multi-location Trials

Genotypes	Grain yield (kg/ha)					Total	Mean
	Z1	Z2		Z3			
	Bidhar	Gulberga	Raichur	Sirguppa	Hagari		
H1	1155	1579	1746	2855	2778	10113	2023
H2	542	1529	1179	2701	2222	8173	1635
H3	879	1575	1248	3133	2130	8964	1793
H4	1124	1679	1223	3920	2537	10483	2097
H5	772	1564	1138	2600	2704	8778	1756
H46	1181	1872	1845	4028	2963	11890	2378
Sia 326(C)	765	1540	913	2068	2574	7859	1572
DHftmv 109 - 3(C)	498	1561	1322	2901	2148	8430	1686
HMT 100-1©	803	1577	1178	3210	2037	8805	1761
Sia2644 (C)	712	1500	1204	3395	2315	9126	1825

Ten genotypes were evaluated in five locations of three agro climatic zones of Hyderabad Karnataka. Among ten genotypes, H46 recorded higher grain yield of 2378 kg/ha compare to four checks

FLD of foxtail millet : 25 acre

Publications:

1. L. N. Yogeesh, Kamble Anand Shankar, S.M. Prashant and G.Y. Lokesh, 2016, Genetic Variation and Morphological Diversity in Foxtail Millet, *International Journal of Science, Environment and Technology*, 4(6): 1540 – 1545.
2. L.N. Yogeesh, S.M. Prashant, P. Sheik Peer and Kamble Anand Shankar, 2016, Promotion of Integrated Farming System For Enhancing the Livelihood of Farmers in Ballari District of Karnataka. *International Journal of Science, Environment and Technology*, 5(5): 3630 – 3634.
3. L.N. Yogeesh, K.P. Viswanatha, R. Madhusudhan and S Gangaprasad, 2016, Morphological diversity and genetic variability in moth bean, *International Journal of Science, Environment and Technology*, 5(4): 1912–1924.
4. L. N. Yogeesh, A. B. Naryanareddy, Y. A. Nanjareddy and M. V. Channabyre Gowda, 2016, High Temperature Tolerant Genotypes of Finger Millet (*Eleusine coracana* L.), *Nature Environment and Pollution Technology*, 15(4): 1293-1296
5. G. Girish, S. B. Kiran, R. Lokesh, Vikas, V. Kulkarni, V. Rachappa, L. N. Yogesh and A. M. Talwar, 2016, Stability analysis for yield and its attributing traits in advanced breeding lines of rabi sorghum (*Sorghum bicolor* (L.) Moench), *Journal of Applied and Natural Science*, 8 (1): 10 – 15.
6. G. Girish, S. B. Kiran, R. Lokesh, Vikas, V. Kulkarni, V. Rachappa, L. N. Yogesh and A. M. Talwar, 2016, Character association and path analysis in advanced breeding lines of rabi sorghum [*Sorghum bicolor* (L.) Moench], *Journal of Applied and Natural Science*, 8 (1): 35– 39
7. K.P. Viswanatha, L.N. Yogeesh and K. Amitha, 2016, Morphological diversity study in Horsegram (*Macrotyloma uniflorum* (Lam.) Verdc) based on Principal Component Analysis (PCA), *Electronic Journal of Plant Breeding*, 7(3): 767-770.

Papers presented in seminars/conferences:

1. Yogeesh L N, Kamble Anand Shankar, S.M. Prashant and Shaila HM. 2016, High Temperature Tolerance Genotypes in Foxtail millet. National conference on Food security issues and Environmental Challenges for Indian Agriculture in the next decade held at University of Punjab, Chandigarh 19 -20th Nov.2016.pp36
2. Yogeesh, L. N., Kamble Anand Shankar, S.M. Prashant and G.Y. Lokesh, 2016, Participatory varietal Selection & Characterization of foxtail using farmer and Breeder Knowledge, National Seminar on Innovative Breeding Approaches for Agricultural Security held from 13-14th March, 2016 organized by ISGPB, Rachi Chapter & Birsa Agricultural University, Ranchi ,pp-45.
3. Yogeesh, L. N., Shilpa, H and Desai B. K. 2016. Characterization of Foxtail millet genotypes for nutritional and Phsico chemical properties. National conference on Innovative and current advances in Agriculture & Allied Sciences, held from 10-11th December, 2016 organized by Society for scientific Development in Agriculture & technology & Astha foundation, UP at Prof. Jayashankar Telangana State Agriculture University, Hyderabad. PP-34.

8. Jagdalpur

- Name of Centre:** S. G. College of Agriculture and Research Station, Kumhrawand, Jagdalpur, IGKV (CG)
Mandate Crops; Finger millet, Kodo millet and Little millet
- Area. Production and productivity:** Total area under small millets was 14.01(000 ha), production 8.95 (000 tones) and productivity 640 kg ha⁻¹ (*Source: Office of the Deputy Director Agriculture, Bastar*).
- Total rainfall received during the year:** Total 1740.20 mm rainfall was recorded with 77 rainy days. Monsoon was withdrawal in the month of October, a single drop of rain was not received after 11th October.
- Significant achievements of the centre**
 - Little Millet Variety Notified**

VARIETY	Chhattisgarh Kutki- 2 (BL 4)
PARENTAGE	CO 2 X TNAU 97
YIELD	10-12Q/ha
RECOMMENDED AREA	CHHATTISGARH
SPECIAL FEATURE	High iron (28.3 mg/ 100 g grain)
Tolerant to major pest	

- Variety Nominated in SVRC:** Little millet genotype BL-41-3 was 1st ranked in All India Coordinated Trials – AVT-2 (*Kharif 2015*) but it was not released by CVRC due to some reasons. The same variety has been nominated in Chhattisgarh State Variety Identification Committee in 2016-17 as Chhattisgarh Sonkutki.

5. Research on Breeding

I. Germplasm maintained, collected, evaluated and use in breeding

Some blast resistant Ragi genotypes have been collected with sturdy plant type. In little millet, bunching panicle type germplasm have been collected from Bastanar Block of Bastar District names BLC-1 and 2. Exploration trip are also conducted in Lohandigudha, Lamker villages and tribal belt of Chhattisgarh and Orrisa state.

Germplasm Status at Center

Crop	Available Stock	Evaluation with Breeding objective	New collection
Finger Millet	84	High yield, earliness, Finger blast resistance	07
Kodo Millet	42	High yield, non-lodging type	-
Little Millet	78	High yield, earliness	03

II. Contribution of breeding materials in AICRP testing

S. No.	Crop	Name/Culture No.	Remarks
1	Finger millet (introduced in <i>Kharif 2016</i>)	1.BR-14-2	Early maturing (106 DAS) Tolerant to leaf and neck blast
		2.BR-14-3	Vary early maturing (93 DAS) Tolerant to leaf and neck blast
2	Kodo millet	1.BK-36	Tolerant to Head Smut
		2.BK-48	

- Development of breeding materials:** As per prime objective of combination and transgressive breeding crosses was attempted to generate more diverse breeding materials in finger millet. The emphasis was higher yield and adaptability in local conditions. Hot water treatment followed by contact method was deployed for making crosses. Since GPU 28 is the most promising and locally adaptable variety, is used as one of parent and crossed with breeding lines developed by the centre.

Cross Combinations	Present Stage
GE 4004 x GE 4129, GE 4004 x BR 14 2, GE 4004 x GPU 28 GE 4129 x BR 14 2, GE 4129 x GPU 28, BR 14 2 x GPU 28	F1

IV. Nucleus and breeder seed programme

Nucleus Seed Production		
Crop	Variety	Quantity Produced
Finger Millet	IR 01	2 Kg
	CG Ragi 02	2 Kg
Kodo	CG Kodo 01	1.5 Kg
	CG Kodo 02	1.75 Kg
Little Millet	BL 4	1 Kg
	BL 6	1 Kg
Breeder Seed Production		
Finger Millet	IR 01	2.00 Qt
	CG Ragi 02	2.50 Qt
Kodo	CG Kodo 01	2.00 Qt
	CG Kodo 02	0.20 Qt
Little Millet	BL 4	0.22 Qt
	BL 6	

V. Status of Coordinated Trials

Crop	Trials Allocated	Trials Conducted
Finger Millet	02	02
Kodo Millet	01	01
Little Millet	01	01

VI. Station trials at the centre

A. Evaluation of Advanced Breeding Lines (Finger Millet): 26 genotypes were evaluated in two bireplicated trials namely Advanced Breeding Trials and Newly Generated Material Evaluation. Collectively, BK-14-1 (15.85 t/ha and 39.93 qt/ha; fodder and grain yield respectively), BK-14-2 (17.33 t/ha and 48.84 qt/ha), BK-14-3 (15.48 t/ha and 46.33 qt/ha) and some others have been found promising regarding overall performance.

Evaluation of Newly Developed Material

B. Advanced Breeding Lines Evaluated (Kodo): 8 breeding lines of Kodo were evaluated. BK-20 (10.57 t/ha and 42.28 qt/ha; Fodder and grain yield respectively), BK-34 (11.06 t/ha and 44.24 qt/ha) and some others have been found to high yielder.

6. Significant Research highlights in other disciplines

A. Agronomy: Effect of different sowing method, nutrient management and seed priming was recorded significant effect during experimentation. The finger millet transplanted after 21 days after sowing with spacing of 30 cm x 10 cm (S2) was recorded significant superior over direct sowing with 30 cm x 10 cm (S1) in terms of plant height, number of tillers, 50% flowering, number of seeds per finger, test weight, yield per plant and per plot, and yield per ha. In nutrient management and seed priming treatments, treatment N4 and P3 was recorded significantly taller plant, more number of tillers, 50% flowering, maximum number of seeds per finger, higher test weight, maximum yield per plant and per plot, and higher yield per ha among all the treatments

B. Plant Pathology :

Exp.1 : Eco-friendly management of banded blight of Kodo Millet: The JK-155 variety was tasted. Seed of Kodo millet was treated with three bio agents as *Trichoderma viridi*, *Pseudomonas fluorescencens* and *Bacillus subtilis* @ 10 g kg⁻¹ seed and Soil application of value added *T. viridi*, *P. fluorescencens* and *B. subtilis* (one kg talc formulation mixed in 25 kg FYM or vermicompost, incubated for 15 days) and its combinations was applied over an acre at the time of sowing. The data of Head Smut and Banded sheath blight per cent diseases index were recorded. The seed treatment with *B. s.*, Soil application of *P. f.*, Seed treatment with *P. f.*, Soil application of *T. v.* and Soil application of combination of *P. f.* + *T. v.* + *B. s.* was found effective against the head smut of kodo millet as compared to control and percent disease incidence are 1.5, 2.1, 2.3, 2.7, 3.1 respectively. The soil application of bio agent's combination

of *P. f.* + *T. v.* + *B. s.* was found effective against the Banded leaf and sheath blight of kodo millet as compared to control and 3.0 percent disease was recorded as followed by seed treatment by *Tricoderma viridi* (5.2 % PDI)

Exp. 2 : Epidemiological study of blast of Finger millet through different Dates of Sowing: The experiment was conducted for epidemiological study on blast of finger millet through different dates of sowing in which six different sowing dates from 18th June 2016 to 23rd July 2016 were used for weekly sowing of finger millet variety BR-36 . The minimum disease incidence was recorded of sowing on 9th July and finger millet crop was less affected by leaf blast and neck blast as 4.4 and 3.2 respectively. The early sown of finger millet on 18th and 25th June was found susceptible and per cent disease incidence was recorded 7.9 and 4.6 respectively.

Exp. 3 : Eco-friendly management of Blast of Finger millet: The experiment was conducted for Eco-friendly management of blast of finger Millet in which 16 treatments. The variety Udru mallige was tasted. Seed of finger millet was treated with three bio agents as *Tricoderma harzianum*, *Tricoderma viridi* and *Pseudomonas fluorescense* at 1 %, 5 %, 10 %, 15 % & 20 % were applied at the time of sowing. The data of leaf blast, neck blast and finger blast per cent diseases incidence were recorded. The seed treatment with *Tricoderma harzianum* and *Tricoderma viridi* @ 20 % and 15 % was found effective against the leaf, neck and finger blast as compared to control and percent disease incidence are 2.1, 2.4, 4.2, 4.7, respectively.

7. CRP-AB Trials, FLDs and TSPs

Name of Trial/FLD/TSP	No. of Trials		Remarks
	Allocated	Conducted	
CRP Agrobiodiversity	01	01	Ragi (1000 Entries)
FLD	25 ha	25 ha	Ragi (10 ha), Kodo (10 ha) Little Millet (5 ha)
TSP	20 ha	20 ha	Ragi (10 ha), Kodo (10 ha)

8. Publications

A. International

- I. Thakur AK, Kumar Prafull, Salam P, Patel RK and Netam CR. 2016. Effect of Different Sowing Methods, Nutrient Management and Seed Priming on Growth, Yield Attributing Characters, Yield and Economics of Finger Millet (*Eleusine coracana* L.) at Bastar Plateau. *Journal of Pure and Applied Microbiology*. 10(1): 407-415.
- II. Sao A, Kumar Prafull, Singh P and Pradhan A. 2016. Genetic analysis for yield and economic traits in finger millet (*Eleusine coracana* (L.) Gaertn.). *Progressive Research – An International Journal*. 11(Special VII): 5314-5319.
- III. Netam R S, Tiwari R.K.S., Bahadur A.N., Kumar Prafull and Yadav S.C. 2016. Efficacy of bio-control agents for the management of (*Pyricularia grisea*) blast disease of finger millet under field condition of Bastar, Chhattisgarh. *Journal of Pure and Applied Microbiology*. 10(3): 2421-2425.
- IV. Sao A, Kumar Prafull, Kumari P. 2016. Genetics of finger millet grain yield in Bastar plateau of Chhattisgarh. *European Journal of Biotechnology and Bioscience*. 4(7):18-19.

B. National

- I. Sao A, Singh P, Kumar Prafull and Pradhan A. 2017. Estimates of Genetic Parameters for Yield and Contributing Traits in Kodo Millet (*Paspalum scrobiculatum* L.). *Research Journal of Agricultural Sciences*. 8(1): 120-122.
- II. Sao A, Singh P, Kumar Prafull and Panigrahi P. 2016. Genetic divergence studies in Indian kodo millet (*Paspalum scrobiculatum* L.). *National Journal of Life Science*. 13(2): 129-132.
- III. Sao A, Singh P, Kumar Prafull and Panigrahi P. 2016. Genetic Analysis for Estimation of Yield Determinants in Finger Millet [*Eleusine coracana* (L.) Gaertn.]. *Advances in Life Sciences*. 5(16): 5951-5956. (NAAS Rating 3.56).

C. Papers in Seminars

- D. Kumar Prafull, Sao A, Thakur A K, Netam R S, Sahu P. 2016. Kodo millet (*paspalum scrobiculatum*) for climate change laid agriculture. In Proceedings "Brainstorming Workshop and Two days National Seminar On Emerging Technologies for Enhancing Water Productivity" organized at IGKV, Raipur on 17-18 Nov, 2016. *Int. Disci./14*. Pp: 93.

E. Awards

- Best Teacher Award to Dr. Ashwani Kumar Thakur for the fourth and Second years students, session 2015-16 on the occasion of Republic Day, 26th January 2016, Awarded by Hon'ble VC, IGKV, Raipur, CG, India.
- Outstanding Achievement Award to Dr. Ashwani Kumar Thakur for outstanding contribution in the field of Agronomy on the occasion of National Conference on "Emerging Challenges and Opportunities in Agriculture, Social, Plant, Environment, Co-operatives and Technology, September, 10-11, 2016 at Indian Institute of Rice Research (IIRR), Rajendranagar, Hyderabad, Telangana.
- Distinguished Scientist Award to Dr. Ashwani Kumar Thakur for outstanding contribution in the field of Agronomy on the occasion of National Conference on Agricultural and Rural Innovations for Sustainable Empowerment during 21-22, May, 2016 held at Kakaitya University and Bala Vikasa, Warangal, Telangana.
- Best Poster presentation award to Dr. Ashwani Kumar Thakur on Effect of tillage methods, sowing date and different irrigation levels on sweet corn at Bastar plateau zone of Chhattisgarh. Brainstorming workshop and National Seminar on Emerging Technologies for Enhancing Water Productivity, November 17-18, 2016, p-65, Raipur, CG, India.
- Outstanding Achievement Award to Prafull Kumar, Scientist, GPB, for outstanding contribution in the field of Plant Breeding on the occasion of National Conference on "Emerging Challenges and Opportunities in Agriculture, Social, Plant, Environment, Co-operatives and Technology, September, 10-11, 2016 at Indian Institute of Rice Research (IIRR), Rajendranagar, Hyderabad, Telangana.

09. ANY OTHER ACTIVITIES

A. External Project Handled

- I. *"Interventional upliftment of socio-economic rural livelihood through processing and marketing of small millets in Bastar"* through National Rural Livelihood mission (NRLM) (Presently State Rural Livelihood Mission; SRLM) of Rs. 169 lakhs for meager people of Bastar region of Chhattisgarh.
- II. *"Conservation of Genetic Resource of rice and millets for Improving Traditional Varieties of Farmers in Tribal Region of Bastar Plateau"* by BRGF-IAP; CG State Govt. of Rs. 25 lakhs.

- B. Promotion of Summer Cultivation of Finger Millet in 30 Acres in Block Bastar, CG. .

9. Kolhapur

Area production and productivity: In Maharashtra finger millet is grown on an area 1.25 lakh ha with a production of 1.42 lakh tones and a productivity of 11.44 q ha⁻¹ during 2013-14. The area of other small millets is not reported in Epitom of Government of Maharashtra.

Total Rainfall : 1067.7 mm, 59 Rainy days, Excess by 5.14 % over normal rainfall (1015.3 mm in 65 RD)

Significant achievements of the centre during the year

Varietal release at State level: Release proposal of Barnyard millet variety Phule Barti (KOPBM 46) and it is recommended for release for cultivation in barnyard millet growing areas of Maharashtra State.

Salient features of Phule Bati (KOPBM 46)

- Proposed for release in areas of Western Maharashtra
- Higher grain yield (15.24 q ha⁻¹) i.e. 37.91 % increase over national check variety VL 172 (11.05 q ha⁻¹).
- High iron (97.38 mg/100g), calcium (6.20 mg/100g) and phosphorus (311 mg/100g)
- Medium duration (95-105 days maturity), Mid dwarf plant type, Thick panicle type, long length, twisted type of fingers and Shiny grey seed colour

Research on Breeding:

i) **Collection, evaluation and maintenance of germplasm:** Three land races of finger millet crop were collected from Panhala area of Kolhapur district of Maharashtra State.

Details	Finger millet (Elite)	Finger Millet (Igatpuri)	White Finger Millet	Kodo Millet	Foxtail Millet	Total
Accessions sown for maintenance	50	45	62	28	60	245
No. Collected (Kh.16)	03	--	--	--	--	02
	53	45	62	28	60	247

ii) Contribution of breeding materials in AICRP testing: KOPN 942 contributed in *kharif* 2016 IVT trial.

iii) No of crosses / progenies in various segregating generations

Generation	No. of cross combinations	No. of IPS	No. of bulks
F ₂	25	--	--
F ₆	4	25	15
F ₇	10	10	10
Total		35	25

iv) Nucleus and breeder seed programme:

Variety	Stage	Quantity (Unprocessed)
Phule Nachani	Nucleus	0.20 qtl
Phule Nachani	Breeder	1.20 qtl.
Phule Nachani	Foundation	4.00 qtl.
Phule Nachani	Truthful	5.40 qtl.
P.Ekadashi	Nucleus	0.10 qtl
P.Ekadashi	Breeder	0.20 qtl
P.Ekadashi	Truthful	0.50 qtl
Total seed produced		11.60 qtl

v) Registration of genetic stocks:

Sr. No	Name of crop	Crop variety	No	Status
1	Finger Millet	Phule Nachani (KOPN 235)	--	Proposal sent to register under PPV&FRA
2	Barnyard Millet	Phule Barti (KOPBM 46)	IC 620841	Register at NBPGR, New Delhi for accession number

vi) Coordinated trials

Sr. No	Discipline	No of trials allotted	No of trials conducted	%
1	Breeding	3	3	100
2	Agronomy	6	6	100

vii) **Multilocation trials:** The promising genotypes of finger millet from Kolhapur and Igatpuri were tested in MLT at 6 locations in MPKV and PDKV jurisdiction. On the basis of means of six locations, the genotype KOPN 942 (21.30 q/ha) gave highest yield followed by KOPN 1059 (20.65 q/ha), KOPN 1052 (19.87 q/ha) and Phule Nachani (19.48 q/ha). Eight genotypes recorded higher yield than the grand mean (18.24 q/ha).

Location wise grain yield (q/ha) data of finger millet Multilocation trial

Sr. No.	Decoding	Entries	Kolhapur	Karad	Radhanagri	Vadgaon maval	Nandurbar	Achlapur (Amravati)	Mean	Rank
1	KWFN 49	KOPIGN 1	19.63	15.60	19.84	16.36	18.27	10.42	16.69	12
2	KWFN 47	KOPIGN 2	18.15	17.19	16.31	16.36	16.67	10.07	15.79	14
3	KOPN 942	KOPIGN 3	24.69	26.07	26.61	19.14	21.05	10.22	21.30	1
4	GE 2370	KOPIGN 4	18.21	23.04	21.69	13.89	20.12	9.63	17.76	9
5	GE 4597	KOPIGN 5	22.22	21.52	22.68	18.52	21.05	10.07	19.34	5
6	GE 1965	KOPIGN 6	18.64	20.66	19.77	16.36	17.40	10.72	17.26	11
7	KOPN 1051	KOPIGN 7	21.75	23.01	22.37	16.05	19.55	9.73	18.74	7
8	KOPN 1059	KOPIGN 8	19.88	29.02	27.73	16.67	19.75	10.86	20.65	2
9	KOPN 1052	KOPIGN 9	23.34	20.47	26.09	15.12	23.21	10.96	19.87	3
10	KOPN 1055	KOPIGN 10	20.48	16.86	19.30	11.73	20.28	10.07	16.45	13
11	P. Nachani (ch)	KOPIGN 11	21.23	25.99	22.52	17.96	19.01	10.17	19.48	4
12	GPU 67 (ch)	KOPIGN 12	20.62	22.65	20.85	16.98	22.84	10.22	19.03	6
13	GPU 45 (ch)	KOPIGN 13	18.83	17.51	25.86	14.20	18.70	10.47	17.60	10
14	IGPFM 08-93-1	KOPIGN 14	21.14	19.41	27.70	13.58	19.07	11.51	18.74	7
15	KWFM 6	KOPIGN 15	14.88	16.49	18.21	13.27	16.67	9.93	14.91	15
		Mean	20.35	21.04	22.50	15.75	19.57	10.34	18.24	
		S.E \pm	1.31	1.62	1.15	1.66	1.35	0.31		
		C.D. at 5 %	3.80	4.71	4.30	4.60	3.73	0.90		
		C.V. %	11.18	13.40		16.80	11.91	5.21		

Multilocation trial on promising genotypes of Little millet : The promising genotypes of little millet from Kolhapur and Igatpuri were tested in MLT at 6 locations in MPKV and PDKV jurisdiction. None of the genotypes recorded higher grain yield than Phule Ekadashi (14.42 q/ha), followed by IGPLM 08-03 (13.62 q/ha) and KOPLM 41 (12.83 q/ha) and KOPLM 76 (12.63 q/ha). Five genotype gave higher yield than grand mean (12.05 q/ha).

Location wise grain yield (q/ha) data of little millet multilocation trial

Sr. No	Decoding	Entries	Kolhapur	Karad	Radhanagri	Vadgaon maval	Nandurbar	Achlapur (Amravati)	Mean	Rank
1	KOPLM 46	KOPLM 1	14.42	6.02	8.89	13.27	11.17	8.54	10.39	10
2	KOPLM 41	KOPLM 2	12.17	11.06	14.92	16.98	13.40	8.44	12.83	3
3	P. Ekadashi (ch)	KOPLM 3	13.02	15.80	18.16	17.90	13.33	8.30	14.42	1
4	IGPLM 08-116	KOPLM 4	10.23	16.98	15.06	12.35	9.99	9.09	12.28	5
5	IGPLM 08-03	KOPLM 5	9.73	15.80	15.03	17.28	13.83	10.03	13.62	2
6	KOPLM 53	KOPLM 6	11.76	8.68	17.69	12.65	10.37	8.20	11.56	6
7	OLM 203 (ch)	KOPLM 7	10.65	7.32	16.44	11.73	10.74	8.15	10.84	8

8	KOPLM 131	KOPLM 8	10.41	4.40	18.22	11.11	10.25	8.35	10.50	9
9	KOPLM 76	KOPLM 9	11.82	9.04	16.31	16.98	13.21	8.40	12.63	4
10	IGPLM 08-2	KOPLM 10	10.06	10.96	14.70	15.12	9.69	8.05	11.43	7
		Mean	11.42	10.54	15.42	14.54	11.60	8.55	12.05	
		S.E ±	0.68	4.27	1.17	0.93	0.65	0.31		
		C.D. at 5 %	2.03	12.69	3.25	2.94	1.81	0.95		
		C.V. %	10.37	14.0	12.34	15.09	9.77	6.45		

Multilocation trial on promising genotypes of Barnyard millet : The promising genotypes of barnyard millet from Kolhapur were tested in MLT at 6 locations in MPKV and PDKV, jurisdiction. On the basis of means of six locations the entry KOPBM 46 (15.46 q/ha) followed by KOPBM 47 (15.14 q/ha) and KOPBM 11 (14.13 q/ha) gave higher grain yield over the highest yielding check VL 129 (12.62 q/ha) and VL 172 (12.30 q/ha). Four genotypes recorded higher yield than the grand mean (13.35 q/ha).

Location wise grain yield (q/ha) data of barnyard millet multilocation trial

Sr. No	Decoding	Entries	Kolhapur	Karad	Radhanagri	Vadgaon maval	Nandurbar	Aachlapur (Amravati)	Mean	Rank
1	KOPBM 47	KOPBM 1	12.21	16.56	24.20	13.58	12.59	11.70	15.14	2
2	KOPBM 11	KOPBM 2	12.38	12.74	22.69	11.42	14.07	11.46	14.13	3
3	KOPBM 34	KOPBM 3	8.13	12.48	16.95	11.11	7.78	11.46	11.32	10
4	KOPBM 46	KOPBM 4	13.12	16.52	23.96	13.27	13.51	12.40	15.46	1
5	KOPBM 39	KOPBM 5	12.12	12.44	18.31	11.73	11.60	13.14	13.22	5
6	VL 129 (ch)	KOPBM 6	10.42	9.66	22.09	11.42	9.87	12.25	12.62	7
7	KOPBM 5	KOPBM 7	10.89	10.34	20.16	10.19	10.00	11.90	12.25	9
8	VL 172 (ch)	KOPBM 8	10.81	9.62	21.56	7.72	11.42	12.67	12.30	8
9	KOPBM 35	KOPBM 9	10.62	12.92	18.89	12.35	11.60	12.00	13.06	6
10	KOPBM 18	KOPBM 10	12.39	14.18	23.31	10.19	11.60	12.00	13.96	4
		Mean	11.31	12.74	21.21	11.30	11.40	12.11	13.35	
		S.E ±	0.70	3.78	1.73	0.129	0.74	0.37		
		C.D. at 5 %	2.08	11.23	4.80	0.338	2.05	1.10		
		C.V. %	10.75	14.4	14.16	15.44	11.24	5.29		

viii) Station trials:

- Station Trial of promising genotypes of finger millet (Early and midlate):** Station Trial- I : Eight e & m fingermillet genotypes were tested along with 2 checks. The grain yield differences were statistically significant. The genotype KOPN 942 (25.83 q /ha) followed by KOPN 1059 (24.77 q/ha) gave superior grain yield over the check VL 149 (22.39 q/ha) and GPU 45 (20.28 q/ha).
- Station trial of promising late maturing finger millet genotypes Station Trial- II:** Late maturity group, nine genotypes were tested for yield and yield contributing characters along with 3 checks. The grain yield differences were statistically significant. The genotype KOPN 1051 (28.89 q/ha) gave superior grain yield followed by KOPN 1052 (27.96 q/ha) and GE 4597 (26.11 q/ha) over the highest yielding check GPU 67 (24.77 q/ha) and Phule Nachani (21.17 q/ha).
- Station trial of promising genotypes of white seeded finger millet Station trial III :** White seeded finger millet group, nine genotypes were tested for yield and yield contributing characters along with 1 check. The grain yield differences were statistically significant. The genotype KWFM 49 (19.75 q/ha) gave statistically significant superior grain yield followed by KWFM 47 (18.21 q/ha) and KWFM 6 (15.87 q/ha) over the highest yielding white check Dapoli Safed (15.70 q/ha).

4. **Station Trial of promising genotypes little millet Station Trial- IV** : Little Millet, eight genotypes were tested along with the check Phule Ekadashi and OLM 203 for yield and yield contributing characters. Grain yield differences were statistically significant. The genotype KOPLM 152 (12.90 q/ha) recorded highest grain yield followed by KOPLM 47 (12.50 q/ha), KOPLM 46 (12.14 q/ha) followed by the highest yielding check Phule Ekadashi (11.26 q/ha).

Agronomy (Coordinated trials)

1. Production package for organic finger millet under rainfed condition: For obtaining highest grain and straw yield, gross and net profit and B: C ratio, application of recommended dose of fertilizer is found beneficial.
2. Chemical weed control studies in finger millet: For effective control of weeds in finger millet, integrated weed control with preemergence application of Isoproturon @ 0.5 kg a.i.ha-1 + 1 inter cultivation was found beneficial.
3. Studies on the effect of sowing dates of different finger millet varieties in relation to climate change: The variety Phule Nachani recorded the highest grain and straw yield (17.71 and 22.66 q ha-1) sown in 4th week of June.
4. Sustainable intercrop association of little millet (*Panicum sumatrense* L.) in Niger (*Guizotia abyssinica* cass.): For obtaining maximum net profit, B:C ratio and highest grain equivalent yield growing of little millet as sole crop seems to be beneficial.
5. Response of pre release varieties of little millet to different fertilizer levels under rainfed conditions: The variety KOPLM 53 recorded the highest grain and straw yield 9.33(q ha-1) with the application of recommended dose (40:20:00 kg NPK ha -1) of fertilizer.
6. Organic farming research in small millets – A comparative study: The application of recommended dose of fertilizer with FYM 5t ha-1 is found beneficial.

Station trial

1. **Response of pre release varieties of Barnyard millet to different spacing and fertilizer levels under rainfed conditions.** The application of recommended dose of fertilizers was found beneficial for obtaining higher grain and straw yield of barnyard millet variety KOPBM 46..

Front Line Demonstrations Implemented Programme *kharif* 2016

Sr. No	Name of crop	Area allocated (ha)	Conducted (ha)	No of FLDs (Beneficiaries)
1	Finger millet	10	10	75
2	Little millet	5	5	25

7. Publications:

Research papers

- Bulbule, A.V., P.N. Gajbhiye R.D. Nigade, and N.Y. Patil.2016. Direct and residual effect of sulphur fertilization to soybean wheat cropping sequence, Crop Res. 51 (1,2,&3) : 22-37.
- Gurav K.V.2016. Knowledge and adoption of recommended ratoon management practices by the sugarcane growers, Agric. Update, 11(4) : 108-110 (2016)
- Salej Sood, T.Patro, Sunil Karad and A.Sao.2016. Evaluation of finger millet genotypes for stability using parametric and non paratateric methods in India, Electronic J. of Plant Breeding, IINS 0975-928X, 2016: 7 (4): Pp. 857-863

Papers in Conferences

- S.D.Kumbhar, C.D.Sarwate and S.R.Karad, Farmers participatory varietal selection of rice landraces Champakali, 1st International Agro biodiversity congress at New Delhi, November 6-9, 2016
- C.D.Sarwate, S.D.Kumbhar and S.R.Karad. 2016,. Participatory plant breeding for improvement in rice landraces Ghansal, 1st International Agro biodiversity congress at New Delhi, November 6-9, 2016.

10. Mandya

1. Name of centre and mandate crops : AICRP (Small millets), VC Farm, Mandya , Finger millet
2. Area, Production and productivity : In Karnataka, the total area coming under finger millet is around 7.5 lakh hectare and the production will be 15.37 lakh tons and the productivity is 2050 Kg/ha.
3. Total rainfall received during the year: 485 mm.
4. Significant achievements of the centre

Information on varietal release, whether at National or State level with characters

The new finger millet variety KMR 340 (White ragi) has been released for Zone-V and Zone-VI. It is early maturing (95-100 days), high yielding variety, rich in protein and iron content, suitable for value addition.

Any major production technology developed at your centre and recommended at National or State level.

Pathology: Soil application of 500 g *P.f.*+ 500 g *T.v* kg talc powder each mixed with 25-30 kg of compost incubated for one week and applied over an acre recommended for management of foot rot disease of ragi in irrigated situation.

5. Research on Breeding (Crop-wise) in brief

1. Germplasm maintained, collected, evaluated and use in breeding: In Finger millet, around 2050 germplasm have been maintained at this centre and nine germplasm lines have been used for crossing programme.

2. i. Contribution of breeding materials in AICRP testing: New ragi variety- KMR 630

ii. Development of breeding materials including crossing programme, no of crosses / progenies in segregating generations

Sl.No.	Generation	Number of crosses	Promising lines
1	New crosses	5	-
2	F1	4	-
3	F2	5	600
4	F3	5	400
5	F4	3	550
6	F5	4	400

iii. Nucleus and breeder seed programme

Sl.No.	Varieties	Area (ha)	Quantity of Breeder seed (kg)	Quantity of Nucleus seed (kg)
1.	MR-1	0.20	300	5.00
2.	MR-6	0.20	300	5.00
3.	KMR-301	0.30	300	5.00
4.	KMR-204	0.30	300	5.00
5.	Indaf-5	0.10	50	5.00
6.	Indaf-7	0.10	50	5.00
7.	Indaf-8	0.10	50	2.00
8.	Indaf-9	0.10	50	2.00
9.	L-5	0.10	50	2.00
10.	KMR-340	0.20	200	2.00

v. Registration of genetic stocks - NIL

vi. Coordinated trials: Mention the allotted no and conducted

Discipline	Allotted	Conducted
Breeding	3	3
Agronomy	8	7
Plant Pathology	03	03

vii. Multi-location Trials in your state : At ZARS, VC Farm, Mandya

Entries	Days to flowering	PH (cm)	NT	NF	FL(cm)	Grain yield (kg/ha)
GPU-94	68	98.07	2.7	6.00	7.10	4850
KMR-316	61	87.10	3.3	5.67	7.07	4640
KMR-204(ch)	60	90.20	3.7	6.00	7.07	4250
GPU-95	72	103.70	3.7	8.67	7.33	4755
GPU-97	74	96.33	3.0	6.67	6.77	4960
KMR-630	61	107.40	4.0	6.00	8.10	4875
GPU-93	72	95.70	3.7	7.67	6.90	4460
KMR-301(ch)	70	108.60	2.7	8.00	7.57	4950
KMR-636	63	96.17	3.3	6.00	8.03	5025
GPU-96	70	103.37	2.7	6.33	8.37	4825
MR-6(ch)	79	120.53	3.0	9.33	8.40	4715
KMR638	56	87.57	3.3	4.67	8.50	2450
S.Em ±						0.31
C.D. (p=0.05)						0.90
C.V. (%)						12.90

Inference: Among the different varieties evaluated under State Multilocation trial during kharif 2016, significantly higher grain yield of 5825 kg/ha was recorded with KMR-636 followed by KMR-630 (5778 kg/ha) compared to check varieties.

Programme	Allotted	Conducted
TSP	01	01
FLDS	10 ha	10 ha

Station trials at the centre (results and table) in brief:

6. Significant Research highlights in other disciplines (Agronomy/Pathology/Entomology) in brief (any new production technology, identification of resistant/tolerant lines for major diseases and insect-pests etc.)

Agronomy:

1. Application of 75% RDF through briquettes is beneficial to obtain higher grain, fodder yield and BC ratio.
2. SRI method of planting in finger millet, proved to be superior over other methods of establishments.
3. In rice- sunhemp - ragi sequence cropping, application of 75%RDF through fertilizers proved to be economical.

Plant Pathology: : Identified three crosses (PR 202 X1409, I-5 X 1409 and I-5 X 2712) as resistant sources (recorded less than one per cent neck and finger blast score).

7. CRP-AB trials, FLD's and TSPs (if allotted)- Mention no of trials allotted and conducted

8. Publications:

International

National: 4 Full length paper

Papers in seminars/conferences

Books/Technical bulletins

Brochures/pamphlets: 4

Awards if any

9. Any other activities: Quality seed production during 2016-17

Sl. No.	Crop	Variety	Class of seed	Expected quantity (qtls)
1	Ragi	KMR-301	FS	250
2	Ragi	KMR-301	CS	100
3	Ragi	Indaf-9	FS	100
4	Ragi	Indaf-9	CS	150
5	Ragi	MR-6	FS	300
6	Ragi	MR-6	CS	350
7	Ragi	MR-1	TL	110
8	Ragi	Indaf-7	TL	250
	Total			1610

11.Nandyal

1. Name of the centre and mandate crops:

Centre: All India Coordinated Research Project on Small millets, RARS, Nandyal.

Mandate crops: Cotton, sunflower, chickpea, small millets, tobacco paddy and sorghum

2. **Area. Production and productivity in 2-3 sentences.** In Andhra Pradesh, foxtail millet is grown in about 30000 ha during 2016-17. However, the area, production and productivity during 2015-16 were 51000 ha, 48000 tonnes and 945 kg/ha, respectively. The main districts include Kurnool, Kadapa, Chittoor, Anantapuram, East Godavari, Prakasam, Visakhapatnam and Vizianagaram. Among all the districts, major area is confined to Kurnool district where the crop is cultivated in about 20000 ha.

Current trends of small millets in Andhra Pradesh

	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16
Area (Lakh ha)	0.30	0.24	0.29	0.29	0.38	0.28	0.20	0.51
Production (Lakh tonnes)	0.23	0.25	0.28	0.18	0.36	0.20	0.13	0.48
Productivity (kg/ha)	766.6	1041.6	965.5	638.5	953	745	725	945

- ❖ Total rainfall received during the year: 911.4 mm
- ❖ The deviation of rainfall during the year 2016 : 6.0 %
- ❖ Rainfall during the crop period (June to December) : 810.6 mm

3. Significant achievements of the centre in brief during the year

- ❖ *Information on varietal release, whether at National or State level with details of characters,*
1. **SiA 3222: It is pre release variety under minikit testing.** It is selection from SiA 3075 x Ise 379. It is an extra early type and matures in 58-60 days. It grows to height of 100-120 cm with panicle length of 14-16 cm. Seeds are medium bold and are orange in colour. Due to its short duration, best fit for double cropping system preceding to bengalgram which is grown in about 2.0 lakh hectares. Therefore, with release of this variety, farmers can successfully grow two crops without any hesitation and thereby increase the net returns.
 2. **SiA 3223 : It is a pre release variety with high yield potential due to extra long panicle.** It is a selection from GS96. It matures in about 88-92 days and is late medium duration type. Grows to a height of 130-160 cm with extra long panicle length of 24-26cm which

Any major production technology developed at your centre and recommended at National or State level

Foxtail millet as profitable preceding crop to chickpea in fallow-chickpea cropping system in black cotton soils: Chickpea is generally grown in about 2.0 lakh hectares with residual soil moisture in black cotton soils of Kurnool district. However, during *kharif*, the land will be kept fallow before taking up chickpea in the month of October. This is mainly because of the farmers' perception that by taking preceding crop the succeeding crop will be affected with insufficient soil moisture. Keeping this in view, trials were taken up to introduce additional crop of foxtail millet instead of keeping land fallow which will not only raise the income of farmer but also pave the way for extending the area under foxtail millet.

Results over the years indicated that net returns of the system were higher with foxtail millet-bengalgram (Rs.32948/- per ha.) system compared to fallow-bengalgram (Rs.24413/- per ha.) system which indicates that there is an advantage of Rs.8535/- per ha with double cropping than single crop of bengalgram. Further, it was also observed

that soil moisture was stabilized at around 15.0% at 75 DAS of chickpea under both systems i.e, fallow-chickpea and foxtail millet-chickpea systems. The technology was very well accepted by the farmers is spreading very fast since the results of first year experiment are so encouraging. On farmers fields, out of three crops tried, foxtail millet fetched the highest net returns compared to bhendi and green gram. Now efforts are going on to spread the technology through DAATT centres, KVKs and Department of Agril. and other NGOs in the state.

4. Research on Breeding (Crop-wise)

i. Germplasm maintained, collected, evaluated and use in breeding

S No	Trait	Mean	Range	S No	Trait	Mean	Range
1	Days to 50% Flowering	47	39 (Prasad)-56 (ISC 144K)	4	Leaf Length (cm)	36.1	21.2 ((ISC 1332)-43.4 (GS 2227)
2	Growth habit		Elongated (5)	15	Leaf Width (cm)	2.1	1.3 (ISC 1332)-9.5 (ISC 276B)
3	Plant Pigmentation		Green (34 entries)-Purple(19 entries)	16	Peduncle Length (cm)	31.0	19.8 (ISC779)-39.4 (ISC 43K)
4	Culm Branching		Light -Medium-High	17	Sheath Length (cm)	12.9	8.2 (ISC779)-17.6 (GS2143)
5	Leaf Colour		Light green-Dark Green	18	Exertion Length (cm)	15.0	7.8 (ISC779) -23.6 (SiA326)
6	Bristle Length		High-Medium-Low/no	19	Lodging %	1.3	1-4
7	Panicle Lobing		Dense Lobed-Medium Lobed-No Lobed	20	Senescence	2.7	1-4
8	Inflorescence Compactness		High-Medium-Low	21	Days to Maturity	83	75 (Prasad)-92 (ISC 144K)
9	Lobe Compactness		Compact-Medium-Low	22	Chlorophyll Content at Maturity	22.0	14.8(SiA2846)-32.3(ISC 174)
10	Plant Height (cm)	134	164.8 (ISC 43K)-92.6 (ISC 1332)	23	Grain Colour		Yellow (3entries)-Cream (44 entries)-Orange (1 entry)-Black (1 entry) – white(4entries)
11	Number of Tillers/Plant	3	4.2 (ISC 40)-1.8 (ISC 278B, ISC1332)	24	Grain Weight (g) 5panicles	19.3	0.8 (ISC 40)-31.0 (Prasad)
12	Panicle Length (cm)	19.7	10.0 (ISC 1332)-26.8 (ISC 2844)	25	Straw Weight (g) (3 m. row)	383.4	154 ((ISC 1332)- 554(ISC 74A)
13	Panicle Width (cm)	1.1	1.0 -2.3 (ISC 779)				

ii. Contribution of breeding materials in AICRP testing

1. SiA 3205, 2. SiA 3163, 3. SiA 3164, 4. SiA 3159, 5. SiA 3179

iii. Development of breeding materials including crossing programme, no of crosses/progenies in various segregating generations in tabular form

Fresh crosses attempted during 2016- 17

Objectives: Extra early and high yielding line development,, assessment of male sterility with elite lines and Extra-long panicle with medium duration line development

Total crosses attempted - 5

Female	Male
SiA 3222 (Extra Early stay green)	SiA 3156 (Medium duration, high yielding)
SIA 1541 (Male sterile)	Suryanandi (Short duration, stay green)
SiA 3223 (Extra high yielding)	

Study of Segregating Generations in foxtail millet for 2016- 17

S. No.	Generation	No. of crosses	No. of pop/ progenies Studied	No. of Single Plants Selected (SPS)
1	F ₂	2		132
2	F ₃	34	212	379
3	F ₄	17	216	176
4	F ₅	11	226	122

Study of F₁ generation: High grain yield with early duration with high Fe & Zn.

S No	Crosses	S No	Crosses
1	SiA 3156 X SiA 3425	14	SiA 3156 X SiA 3217
2	SiA 3156 X SiA 3357	15	SiA 3156 X SiA 1162
3	SiA 3156 X SiA 3221	16	SiA 3142 X SiA 3221
4	SiA 3156 X SiA 3223	17	SiA 3142 X SiA 3193
5	SiA 3156 X SiA 3222	18	SiA 3142 X SiA 3218
6	SiA 3156 X SiA 4148	19	SiA 3142 X SiA 3222
7	SiA 3156 X SiA 4152	20	SiA 3142 X SiA 3219
8	SiA 3156 X SiA 4153	21	SiA 3142 X SiA 3304
9	SiA 3156 X SiA 3193	22	SiA 3142 x SiA 3303
10	SiA 3156 X SiA 3218	23	SiA 3142 X SiA 3302
11	SiA 3156 X SiA 3219		
12	SiA 3156 X SiA 3278		
13	SiA 3156 X SiA 3280		

F₂ generation

S.No.	F ₂ s	SPS	Objective
1	SiA 3156 X SiA 3221	76	High grain yield with extra early duration
2	SiA 3156 X SiA 3223	56	High grain yield with long compact panicle
		132	

F₃ generation

S.No.	F ₃	Single Plants Studied	SPS	Objective	S.No.	F ₃	Single Plants Studied	SPS	Objective
1	SiA 3221 X ISC 1468	9	15	Early with male sterile	19	SiA 3221 X ISC 376	17	10	Extra short duration
2	SiA 2593 X SiA 1541	25	10	Early with male sterile	20	SiA 3085 X ISC 376	15	12	High grain yield
3	SiA 2593 X ISC 1204	17	10	High yield with compact short panicle	21	SiA 3085 X RFM 93	23	10	High grain yield
4	SiA 2593 X G.S 96	15	15	High yield with compact short panicle	22	SiA 3156 X RFM 93	22	12	High grain yield
5	SiA 3222 X ISC 1204	23	10	Extra short duration with compact short panicle	23	SiA 3221 X RFM 93	18	12	Extra short duration
6	SiA 3088 X G.S 96	22	10	Short duration with long panicle	24	SiA 3085 X ISC 1468	19	10	High grain yield
7	SiA 3221 X G.S 96	18	10	Extra short duration with long panicle	25	SiA 2593 X RFM 93	17	12	High grain yield
8	SiA 2593 X ISC 1468	19	10	High grain yield	26	SiA 3088 X SiA 1541	17	10	Extra short duration
9	SiA 3156 X ISC 1204	17	10	High grain yield	27	SiA 3088 X RFM 93	30	12	Extra short duration
10	SiA 3222 X G.S 96	17	12	Extra short duration	28	SiA 3221 X ISC 1204	15	10	Extra short duration
11	SiA 3088 X ISC 376	30	12	Extra short duration	29	SiA 3222 X SiA 1541	17	10	Extra short duration
12	SiA 3222 X ISC 1468	15	10	Extra short duration	30	SiA 3088 X ISC 1204	13	12	Extra short duration
13	SiA 3156 X G.S 96	17	10	High grain yield	31	SiA 3221 X SiA 1541	15	12	Extra short duration

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14	SIA 3156 X ISC 376	13	10	High grain yield	32	ISC 1026 X ISC 1593	18	10	Long compact panicle
15	SIA 3222 X RFM 93	15	12	Extra short duration	33	SIA 3156 X SIA 1541	15	12	High grain yield
16	SIA 3085 X SIA 1541	18	10	High grain yield	34	ISC 1026 X ISC 1581	25	15	Long compact panicle
17	SIA 3088 X ISC 1468	15	12	Short duration	35	SIA 3221 X ISC 1468	17	15	Early with male sterile
18	SIA 3085 X G.S 96	25	10	High grain yield	36	Total		379	

F₄ generation

S No	F ₄	Single Plants Studied	SPS	Objective
	ISC 375 X LEPAKSHI	20	10	Short compact panicle
	ISC 376 X SR 51	26	10	Short compact panicle
	ISC 931 X ISC 1418	20	12	High grain yield
	ISC 1789 X ISC 1418	24	10	High grain yield
	LEPAKSHI X SIA 1541	22	12	Drought tolerant with male sterile line
	SR 51 X SIA 1541	15	10	Long loose panicle with male sterile
	LEPAKSHI X ISC 1468	18	12	Drought tolerant
	ISC 1418 X ISC 931	26	12	High grain yield
	ISC 1468 X SR 51	20	10	Long loose panicle
	ISC 1468 X ISC 1789	10	10	High grain yield
	MEERA SR - 16 X SIA 1541	15	10	Stay green
	LEPAKSHI X ISC 376	24	12	Drought tolerant
	ISC 375 X SR 51	22	10	short compact panicle with long loose panicle
	ISC 1468 X G.S 592	15	8	High grain yield
	MEERA SR 16 X ISC 375	18	10	Stay green with short compact panicle
	MEERA RS 16 X ISC 1468	26	8	Stay green with compact panicle
	ISC 376 X MEERAR SR 16	20	10	Compact panicle with stay green
	Total		176	

F₅ generation

S No	F ₅	Single Plants Studied	SPS	Objective
1	GS 445 X PRASAD	20	10	Short duration with compact panicle
2	SIA 2884 X G.S 445	26	12	Long panicle with compact panicle
3	G.S 1918 X PRASAD	20	8	Compact panicle with short duration
4	G.S 1918 X SIA 2723	24	6	Compact panicle with grain yield
5	SIA 2884 X G.S 1918	22	10	Long panicle with compact panicle
6	SIA 2723 X G.S 445	15	10	High grain yield with compact panicle
7	GS 445 X SIA 2884	18	15	Compact panicle with long panicle
8	G.S 445 X SIA 2723	26	12	Compact panicle with grain yield
9	G.S 1918 X SIA 2884	20	12	Compact and long panicle
10	SIA 2723 X G.S 1918	20	15	High grain yield with compact panicle
11	PRASAD X G.S 445	15	12	Short duration with compact panicle
	Total		122	

iv. Nucleus and breeder seed programme (tabular form)

Crop	Variety	Seed Produced (Approximately)
Foxtail Millet	Prasad	4.5 Q
	Krishnadevaraya	0.5 Q
	Narasimharaya	0.5 Q
	Srilakshmi	0.5 Q
	SIA 3085	100.0 Q
	Surya Nandi	6.0 Q
	SIA 3156	100.0 Q
	Total	Q

v. Registration of genetic stocks

S.No.	Crop	Entry	IC Number
1	Foxtail Millet	SiA 3085	IC 594474
2		SiA 3088	IC 593733
3		SiA 3121	IC 594475
4		SiA 2644	IC 594511
5		SiA 3156	IC 598727

vi. Coordinated trials: Allotted trials: 2 Conducted trials: 2

vii. Multi-location Trials in your state with results (results and table)

MLT	Days to 50% flowering	Days to maturity	Plant Height (cm)	No of Tillers/ plant	Panicle Length (cm)	Grain Yield (kg/ha)	Straw Yield (kg/ha)
SiA 3223	56	86	125	3	26	3777	4630
SiA 3156	52	85	115	3	24	3243	5185
SiA 3085	53	84	118	2	20	3148	4259
SN	45	71	112	2	18	2942	4028
SiA 3222	32	59	86	1	16	2906	3843
Prasad	49	75	122	2	16	2765	4213
Mean	48	76	113	2	20	3130	4360
Max	56	86	125	3	26	3777	5185
Min	32	59	86	1	16	2765	3843
SEm±						240.6	462.7
CD (P=0.05)						684.8	1369
CV%						15.59	18.10

Results: In multi location trial, out of six entries tested, SiA 3223, SiA 3156 and SiA 3085 produced higher grain yield (3777, 3243 and 3148 kg/ha, respectively) than mean but statistically comparable each other.

viii. Station trials at the centre (results and table) in brief.

Table.1 Setaria Advanced Varietal Trial-(SAVT) Yield & Yield attributing Characters

SAVT	Days to 50% Flowering	Days to Maturity	Plant Height (cm)	No of Tillers /Plant	Panicle Length (Cm)	Grain Yield kg/ha	Fodder Yield kg/ha
SiA 3159	55	75	121.5	2.1	17.9	3536	6049
SiA 3163	48	70	109.4	2.2	15.3	3510	4568
SiA 3212	53	75	117.4	2.2	19.6	3457	6111
SiA 3219	52	75	128.9	2.3	22.4	3344	6914
SiA 3220	51	76	108.3	2.2	19.5	3281	4136
SiA 3274	51	75	113.1	2.1	17.8	3226	4568
SiA 3275	54	77	118.9	2.4	16.9	3194	5185
SiA 3278	52	72	108.9	2.1	15.1	3101	5309
SiA 3296	50	75	105.0	2.3	20.2	3067	4383
SiA 3297	54	78	109.3	2.1	20.8	3054	4938
SiA 3300	53	79	124.4	2.2	18.7	3030	4444
SiA 3304	54	76	110.5	2.2	19.8	2978	3457
SiA 3307	51	76	110.9	2.2	17.3	2801	4691
SiA 3309	51	76	115.0	2.2	17.5	2779	5247
SiA 3310	53	77	116.1	2.3	20.1	2758	4753
SiA 3312	51	72	119.8	2.2	18.9	2736	3951
SiA 3156 (c)	55	77	120.5	2.1	20.1	2721	5185
Mean	52	75	115	2	19	3093	4935
Max	55	79	129	2	22	3536	6914
Min	48	70	105	2	15	2721	3457
SEm±						185	333
CD (P=0.05)						518	962
CV%						10.19	11.67

Results: In SAVT, among 16 entries tested, SiA 3159 and SiA 3163 recorded significantly higher grain yield (3510, 3457 and 3344 kg/ha, respectively) than check SiA 3156 (2721 kg/ha). As regards the straw yield, SiA 3159 recorded significantly higher straw yield but comparable with SiA 3212, SiA 3219, SiA 3309, SiA 3278, SiA 3274 and SiA 3309.

Table.2 Setaria Initial Varietal Trial-(SIVT) Yield & Yield attributing Characters of Trial

SIVT	Days to 50% Flowering	Days to Maturity	Plant Height (cm)	No of Tillers/ Plant	Panicle Length (cm)	Grain Yield (kg/ha)	Fodder Yield (kg/ha)
SiA - 4149	49	69	114	2.1	16.9	3314	3642
SiA - 3299	49	72	117	2.4	15.3	3210	4753
SiA-3156 (C)	49	70	123	1.9	18.6	3143	4074
SiA - 3303	49	70	101	2.3	13.8	3062	3765
SiA - 3302	52	74	113	2.4	17.8	2988	4630
SiA - 4148	51	71	120	2.2	15.7	2954	4753
SiA - 4155	53	74	116	1.8	16.3	2952	5123
SiA - 4156	50	73	104	2.4	18.1	2693	4259
SiA - 3308	51	74	108	2.4	15.5	2580	3580
SiA - 3314	51	74	107	2.1	16.0	2542	5000
SiA - 4154	52	75	109	2.3	15.1	1954	3827
Mean	51	72	112	2	16	2854	4310
Max	53	75	123	2	19	3314	5123
Min	49	69	101	2	14	1954	3580
SEm±						203	333
CD (P=0.05)						592	999
CV%						12.10	13.69

Results: In SIVT, out of 10 entries tested, only two entries viz., SiA 4149 and SiA 3299 produced higher grain yield (3314 and 3210 kg/ha, respectively) than check (SiA 3156) but statistically at par each other.

Table.3 Setaria Observational Yield Trial (OYT) Yield & Yield attributing Characters

OYT	Days to 50% Flowering	Days to Maturity	Plant Height (cm)	No of Tillers/Plant	Panicle Length (Cm)	Grain Yield (kg/ha)	Fodder Yield (Kg/ha)
SiA 4201	54	87	140	1.9	24	3604	5370
SiA 4203	55	88	122	2.2	18	3481	6111
SiA 4210	55	87	124	2.2	17	3222	4876
SiA 4206	52	85	131	2.2	19	3093	5309
SiA 3156 (C)	50	82	120	2.3	18	3000	4315
SiA 4200	55	88	126	2.1	19	2985	5865
SiA 4209	55	87	128	2.0	20	2870	5124
SiA 4205	53	85	110	2.2	18	2852	5185
SiA 4204	56	89	123	2.5	19	2704	6111
SiA 4202	55	88	112	2.1	17	2463	4569
SiA 4207	53	86	131	1.7	19	2444	4691
SiA 4208	56	87	121	1.9	22	1667	5246
Mean	54	87	124	2	19	2865	5231
Max	56	89	140	2.5	24	3604	6111
Min	50	82	110	1.7	17	1667	4315

FLDs: A total number of 20 FLDs were allotted to be conducted by the Small millets unit at RARS, Nandyal. All the 20 FLDs were organized by covering 28 farmers in 20 hectares with three components viz., improved variety, inter cropping and sequence cropping. One field day was also organized at Yagantipalle of Kurnool district as part of FLDs programme.

5. Publications

vi. International

1. Padma N, C.V. **Chandra Mohan Reddy**, Gerald Hankins, Andreas Ebert, Doil Choi, John Stommel and Umesh K Reddy (2017). Genome-Wide Divergence and Linkage Disequilibrium Analyses for *Capsicum baccatum* Revealed by Genome-Anchored Single Nucleotide Polymorphisms. **Frontiers in Plant Sciences 7: 1646. doi: 10.3389/fpls.2016.01646.**
2. UK Reddy, **CVCM Reddy** and Andrew H Paterson et al. (2017). Genome-wide divergence, haplotype distribution and population demographic histories for *Gossypium hirsutum* and *Gossypium barbadense* as revealed by genome-anchored SNPs. **Nature Scientific Reports, 7:41285 | DOI: 10.1038/srep41285.**
3. BV Reddy, CVCM Reddy, A Chandrasekhar and B Gopala Reddy (2016). Genetic characterization of elite kodo millet lines using cluster and principal component analyses. **Progressive Research – An International Journal. Volume 11 (Special-VII) : 4625-4630.**
4. BV Reddy, **CVCM Reddy**, A Chandrasekhar and B Gopala Reddy (2016). Genetic characterization of elite finger millet lines using cluster and principal component analyses. **Progressive Research – An International Journal Volume 11 (Special-VII): 4631-4636.**

vii. National

1. BV Reddy, **CVCM Reddy**, PVRM Reddy & B Gopala Reddy (2016). Genetic characterization of promising proso millet lines using cluster and principal component analyses. **J. Res. ANGRAU 44(3&4): 50-58.**
2. S. Jaffar Basha A. Sitha Rama Sarma and **P.Munirathnam** 2017 Probability Analysis of Weekly Rainfall for Crop Planning at Nandyal of Andhra Pradesh. **Trends in Biosciences 10 (2).**
3. K. Prabhakar, P. Pulli Bai, **P. Munirathnam**, J. Manjunath, T. Raghavendhra, Y. Padmalatha And B. Gopal Reddy 2016 Supplementation of Nitrogen and Potassium Nutrients through foliar nutrition to Bidi Tobacco (*Nicotiana Tabacum* L.) J. Res. ANGRAU 44(3&4) 27-32

viii. Papers in seminars/conferences

S. No.	Authors	Year	Title	Seminar/Symposium/ Conference,
1	S. Jaffar Basha , P.Munirathnam and B.Gopal Reddy	2016	Rainfall probability analysis for foxtail millet (<i>Setaria italica</i> L.) crop planning at Nandyal of Andhra Pradesh	National symposium AGMET 2016 on Climate - driven Food Production Systems Agro-meteorological Interventions, 20-22 December 2016 TNAU, Coimbatore
2	BV Reddy, CVCM Reddy, PVRM Reddy & B Gopal Reddy	2017	Exploration of elite foxtail millets using cluster and principal component analyses.	"Trends in Farm Mechanization and Engineering Interventions for Sustainable Agriculture" on January, 2017.

1. **Books/Technical bulletins:** *Mutaka Dhanyala Saagu mariyu vaati Uthpaadakaala thayaari.*

ix. Brochures/pamphlets:

1. *Korra saagulo uttama paddathulu mariyu melakuvalU (Best management practices for cultivation of foxtail millet)*

12. Ranichuuri

Centre Name: Ranichauri Centre, V.C.S.G. Uttarakhand University of Horticulture and Forestry, Bharsar.

Mandate Crops: Finger Millet and Barnyard Millet.

1. Area Production and Productivity: 2016-17

S. No.	Crops	Area (ha)	Production (MT)	Productivity (q/ha)
1.	Finger Millet	107175	159606	14.89
2.	Barnyard Millet	55437	78477	14.16

2. Total rainfall received during the year: 536.67 mm

3. Significant Achievements of the centre:

- The following entries of finger and Barnyard millets are in multi-location trials of our state (SVT):

Sl. No.	Finger Millet	Barnyard Millet
1	UURM-2013-1	UURB-2013-1
2	UURM-2015-1	PRB-903
3		PRB-2012-1
4		UURB-2015-1

Major production technology developed by centre and recommended at National or State level.

1. To manage weed problem we can use 15 kg seed per hectare along with one inter cultivation and one hand weeding. Which increase grain yield 30 % over normal seed rate @ 10 kg seed rate.
2. VL 379 gave 24.9 % higher yield than GPU45 at 40:20:20 (recommended dose of fertilizer).

4. Research on Breeding (Crop-wise)

Multilocation Trials

Standard Varietal Trial on Finger Millet: For State Varietal Trial in finger millet, a total of ten entries were tested for grain yield and different agronomical traits. Among all, two entries MH-901/2016 and MH-907/2016 showed highest mean performance in relation to seed yield (10.22 q/ha and 10.36 q/ha respectively). Other entries showed satisfactory mean performance. The significant differences with the sufficient variability in all the entries were observed through the analysis of variance for seed yield.

Standard Varietal Trial on Barnyard Millet: For State Varietal Trial in Barnyard millet, a total of twelve entries were tested for grain yield and different agronomical traits. Most of the entries showed high mean performance. Among all the entries, BY-912/2016 (20.13 q/ha) followed by BY-904/2016 (18.97 q/ha) and BY-902/2016 (18.96 q/ha) showed highest mean performance. The highly significant differences were observed in all the entries. Therefore the sufficient variability was present among all the entries for seed yield.

viii. Station Trials at the centre

Station Trial on Finger Millet: This trial consisting of 30 germplasm of finger millet along with one local check PRM-1. They were evaluated for yield and other agronomic parameters. Among the 30 screened germplasm, PRM-4 showed maximum seed yield and also found significantly superior in other agronomic parameters also when compared with most of the screened germplasm followed by PRM-6 and PRM-17 which were statistically at par. However, the local check PRM-1 showed maximum seed yield.

Station Trial on Barnyard millet: This trial consisting of 30 germplasm of Barnyard millet along with one local check PRJ-1. They were evaluated for yield and other agronomic parameters. With respect to the seed yield, among

all the germplasm screened, LRB- 26 proved to be best followed by LRB-26 which were statistically at par followed by local check PRJ-1

5. SIGNIFICANT RESEARCH HIGHLIGHTS

PLANT PATHOLOGY HIGHLIGHTS (Associated Scientist: Dr. Laxmi Rawat)

- Out of 1000 finger millet germplasm, screened against biotic stress (*Cercospora* leaf spot disease) under CRP-Agrobiodiversity, more than 200 were found resistant against CLS disease.
- Soil application of value added vermicompost impregnated by *Trichoderma viridae* was found to be best in suppressing sheath blight and brown spot diseases in Barnyard millet (PRJ 1) (0.00 % and 2.33 G respectively) at the same time improving yield (23.13 q/hac) and other growth parameters recorded followed by Soil application of value added vermicompost impregnated by *Pseudomonas fluorescens*.
- Weather data were correlated with cercospora leaf spot disease development in finger millet crop. Regular epidemiological factors like minimum temperature, maximum temperature, rainfall, relative humidity first and second were recorded starting from sowing to harvesting of the crop. Occurrence of cercospora leaf spot disease was recorded by visual observation following 0-9 scale just after initiation of disease in the crop. It was observed that **disease development was high with high temperature and low rainfall at Ranichauri centre.**
- Management of important endemic diseases (grain smut and brown spot) of Barnyard millet (*Echinochloa frumentacea*) by the use of bio-control agents was studied. , investigations were undertaken to identify sources other than chemicals which could provide resistance against these diseases in susceptible but locally preferred variety of Barnyard millet (VL 207). A total of three fluorescent *Pseudomonas* isolates viz., UUHF Psf -4, UUHF Psf-2 and UUHF Psf-1 were selected from the repository of Biocontrol Laboratory of Plant Pathology Division, Ranichauri. Those isolates had previously been tested for Phosphate solubilisation, Siderophore production and HCN production ability. Maximum grain smut disease control (91.92%) and brown spot disease control (75.99) was recorded by Soil application of value added vermicompost impregnated by fluorescent *Pseudomonas* isolate UUHF Psf- 4. Maximum grain yield (23.13 q/ha), highest per cent increase in grain yield (64.86%) and highest per cent avoidable loss (39.34%) was also recorded in the same treatment. Soil application of value added vermicompost impregnated by fluorescent *Pseudomonas* isolate UUHF Psf -1 was next best treatment and recorded 70.96 % grain smut disease control and 63.98 % brown spot disease control, 32.77 % avoidable loss and 48.75 % increase in grain yield.

The above research merits attention and could additionally open the avenue for the use of above mentioned bio-control agents in suppressing the most destructive diseases of Barnyard Millet at the mid hill regions of Uttarakhand.

AGRONOMY HIGHLIGHTS (Agronomy Scientist : Dr. Ajay Kumar Yadav)

- Checking the performance of early duration pre released variety and found that VL 379 yielded 24.9 % higher than national check GPU45 at recommended dose of NPK (50:40:25 kg/ha)
- Inter cropping of Finger Millet and Amaranthus (90:10 by weight and line sowing) gave 1712 kg/ha FMGEY and B:C ratio 2.21: 1 while B:C ratio of farmer practice (mixing of seed at 60:40 by weight and broadcasting) was 1.65:1.
- Inter cropping of Barnyard Millet and Amaranthus (90:10 by weight and line sowing) gave 2012 kg/ha BMGEY and B:C ratio 2.73: 1 while B:C ratio of farmer practice (mixing of seed at 60:40 by weight and broadcasting) was 1.70:1.
- To manage weed problem we can use higher seed rate @ 15 kg seed per hectare (M1- establishment method) along with one intercultural and one hand weeding which increase yield 30% normal seed rate i.e. 10 kg per hectare.
- Barnyard millet and Proso millet perform better under integrated nutrient management than inorganic and organic nutrient management in first year of the trial.

6. **CRP-AB trial:** Allotted (One thousand entries were screened against *Cercospora* leaf spot disease, a major emerging problem in hills of Uttarakhand)

FLD'S: Target : 20 hac.

Crop: Finger millet and Barnyard millet crops (10 hac. in each mandate crop) **Achievement:**

Thematic area: Seed replacement with improved varieties (PRM 2 in Finger Millet and PRJ 1 in Barnyard Millet)

True Seed production of Finger millet (PRM-2) and Barnyard millet (PRJ-1) was carried out at Gaja Research Station in 2016-17 and supplied to State Government, NGO's and KVK's. The quantity of seed produced at Gaja Research Station during *kharif 2016-17* is mentioned below:-

Sl. No.	Finger Millet (Quintal)	Barnyard Millet (Quintal)
1	3 Quintal	4 Quintal

Field days were also organized for creating awareness among farmers for developed varieties and to receive feedback.

Date: 23.09.2016 (In Barnyard Millet), **Venue:** Tegna Village, District Tehri Garhwal

Date: 25.10.2016 (In Finger Millet), **Venue:** Salamkhet, Maun Village, District Tehri Garhwal

Two farmers training programmes were conducted on "Importance and production technology of coarse cereals under climate change scenario". 27.07.2016 and 30.08.2016.

Exposure visit of farmers from twenty villages of Bhilangana Block and Koteshwar area was conducted at College of Forestry, Ranichauri on 25.11.2016 (Beneficiaries= 50).

7. PUBLICATIONS:

1. Laxmi Rawat and Akshit Kukreti (2016). Evaluation of *Pseudomonas fluorescens* from rhizospheric soil of finger millet (*Eleusine coaracna* L.) and assessment of their phosphate solubility: *In vitro* study. Progressive Research- An International Research Journal. 11(1): 321-323.
2. A. Nagaraja, Suresh Patil, B.S. Chetna, Laxmi Rawat (2017). Prevalence of *Cercospora* Leaf Spot (CLS) in the mid hills of Uttarakhand. Journal of Mycopathological research 54 (4): 547:549.
3. Laxmi Rawat, Akshit Kukreti and Tejpal Singh Bisht. (2017). Seed bio-priming with *Pseudomonas fluorescens* isolates enhances growth of finger millet plants and induces resistance against drought stress. *Journal of Hill Agriculture*. (Communicated). (NAAS Rating=4.94, ISSN=0976-7606).

PAPERS PRESENTED IN SEMINARS/CONFERENCES/ABSTRACTS

1. Laxmi Rawat and Akshit Kukreti. Evaluation of *Pseudomonas fluorescence* isolates against *Sclerotium rolfsii*, causing foot rot of finger millet (*Eleusine coaracna* L.) in Mid Hills of Uttarakhand. In 10th Uttarakhand State Science and Technology Congress held at Dehradun, Uttarakhand, dated on 10-12 February, 2016. P- 2
2. Laxmi Rawat , Akshit Kukreti and Tejpal Singh Bisht (2016). Responses to drought induced stress in Finger millet (*Eleusine coracana* L.) after seed priming with bio-prospecting drought tolerant *Trichoderma* isolates. In: National Seminar on "Hill Agriculture In Perspective" dated on 26-28 February, 2016 at G. B. Pant University of Agriculture & Tech., Pantnagar. Pp 762-763.
3. Laxmi Rawat and Akshit Kukreti. Management of blast disease and improvement in growth parameters of Finger millet (*Eleusine coracana* L.) by using fluorescent pseudomonads in Mid Hills of Uttarakhand. In the National Conference on "Natural Resource Management Avenues and Application" at Uttara Bio fest -2016, Uttaranchal (P.G) College of Bio medical Sciences and Hospital, Dehradun, Uttarakhand dated on 18-19 March, 2016. Pp- 18.

4. Akshit Kukreti, Neelam Kurumanchali, Laxmi Rawat and Tejpal Singh Bisht (2017). Isoaltion and Characterization of fluorescent pseudomonads and their effect on plant growth promotion and delay in drought response in finger millet. *In 11th Uttarakhand State Science and Technology Congress held at Vigyan Dham, Jhajra, Dehradun, Uttarakahnd, dated 02-04 March, 2017.* Pp-2.
5. Suresh Patil, A. Nagaraja, Prabhakar, and Laxmi Rawat. (2016). *Drechlera panici-miliacei* the cause of leaf blight of proso millet. *In National Symposium on Recent Advances in Plant Health Management for Sustainable Productivity, held at UAS, Dharwad, Dec. 15-16.P- 18*

V. PAMPHLETS: Jhangora: Uttarakhand ke Parvatiyay Shetron Ki Paramparagat Fasal.

VI. AWARDS IF ANY

Sl. No.	Award Name	Scientist	Year	Organization
1.	Best Paper Award	Dr. Laxmi Rawat	2016	4 th International Conference on RAAHS-2016, Jodhpur.
2.	Young Scientist Award	Dr. Laxmi Rawat	2016	4 th International Conference on RAAHS-2016, Jodhpur.

8. ANY OTHER ACTIVITIES

- I. Guided one M. Sc. student (Mr. Akshit Kukreti I.D No. UUHF/13202) as Co- Advisor on the thesis topic "Improvement in seed performance, management of diseases and dealy in drought response of finger millet (*Eleusine Coracana* L.) through bio-prospecting fluorescent *Pseudomonas* spp. with respect to their plant growth promotion and biocontrol activities.
- II. Student also got first prize for oral Presentation from his thesis work on the topic "Management of blast disease and improvement in growth parameters of Finger millet (*Eleusine coracana* L.) by using fluorescent pseudomonads in Mid Hills of Uttarakhand". *In the National Conference on "Natural Resource Management, Avenues and Application", Uttara Bio fest -2016. Uttaranchal (P.G) College of Bio medical Sciences and Hospital, Dehradun, Uttarakhand, dated on18-19 March, 2016.*

13. Ranchi

Mandate Crops: Finger Millet & Little millet

1. Area production and Productivity of Ragi during 2012-13

Area		Production		Productivity	
,000 ha	Growth Rate (%)	,000 MT	Growth Rate(%)	Kg/ha	Growth rate (%)
12.56	29	10.58	36	842	139

Source - Department of Agriculture and Cane Development Government of Jharkhand

2. Rainfall received

- Rainfall from May to Nov. 2016 = 1413.3mm spread in 53 days
- Rainfall in 3 months (July to Sept.) = 1050.5mm spread in 36 days

3. Variety Birsa Marua -3 (Tested in Natl. Network as BBM-10) released for the State. The variety is the outcome of segregating material (VL253 x IE 2826) .

Birsa Marua-3 matures in 110-112 days, finger-pale yellow at maturity, seeds - round and yellowish brown, moderately resistant to neck and finger blasts and resistant to brown spot, banded blight and foot rot. Found absolute resistant to major insect/pest. Suitable for sowing upto July with optimum seed rate of 8-10 kg/ha. Fertilizer responsive upto 150% level of RDF with yield advantage of 10-15% over RDF. Tolerant to lodging. More tolerant to moisture stress as compared to existing varieties recommended for Jharkhand as could be observed under natural condition at ZRS, Chianki (Plamau).

4. Research on Breeding

(i) Germplasm

- 31 finger millet germplasm collected by Dr. Jaylal Mahto, Jr. Scientist (Potential Crops) alongwith Dr. R.S. Rathi, I/c NBPGR, Ranchi Centre was rejuvenated.
- 80 finger millet germplasm procured from ICRISAT in 2014 were screened for drought tolerance; the tolerant entries are being presently studied by Dr. Anita's group in College of Biotechnology of the University.
- 50 finger millet core germplasm procured from the Co-ordinating unit for assessment of their performance broadly with respect to yield, abiotic stresses and maturity period.
- The entries GE 320, GE 3457, BBM-10, VL-352, GPU 67, A404, GE 414 and GE 3885 were found promising.

The result of 50 core germplasm plus the checks revealed that:

- BBM-10 and GE-320 were the most tolerant entries against neck and finger blasts and were the highest yielders also. Both have 30-45 degree of inclination from vertical axis, i.e., slightly lodging.
- The genotypes have been grouped in eight clusters. Clusters VII (12) and VIII (9) showed wide genetic variability. Based on our previous observation BBM-10, GE 320, VL-352, GPU-67 and A404 have been found common in the present study by the student.

(ii) Contribution of Breeding materials in AICRP Testing: Nil

(iii) **Development of breeding materials:** We got the crossed seeds of GPU 28 X A404. F4 generation was taken during 2015. Generation advancement of selected lines could not be managed due to heavy rains.

(iv) **Nucleus and Breeder seed Programme**

Crop	Variety	Nucleus seed (kg)	Breeder seed (kg)
Ragi	A404	8	20# 13*
BM-2		2	- 06*
BM-3 (BBM10)		6	15# -
JWM-1		5	10# -
Gundli	BG-1	1	- -

Produced under the project,

* Produced by NSP (BAU) against indent.

Registration of genetic materials: BBM-10 with NBPGR as IC614775

(v) **Coordinated Trials**

Crop	Allotted	Conducted
Finger millet	2	2
Little millet	1	1
Kodo millet	1	1
Foxtail millet	1	1

- (vi) **Station Trials:** The entries before putting in Natl. Network is tested against promising checks and also to test their suitability in different agro-ecological zones of the state. Additional angle has added for the climate change. Eyes are being kept on the proven check and released varieties on their smartness in changing climate with respect yield and biotic stresses.

Finger millet station Trials 2016

Sl. No	Entries	50% Flowering	Maturity	Fodder yield t/ha	Grain yield q/ha
1	BBM-13	76	112	16.7	41.3
2	BM-2*	69	104	19.4	39.6
3	JWM-1	73	107	21.3	33.0
4	A404*	76	112	15.7	42.6
5	BBM-10	77	113	12.6	42.0
6	VL-149*	55	90	17.2	33.8
7	GPU-67*	77	118	25.4	38.3
8	RAU-8*	68	107	16.7	39.4
9	HR-374*	76	112	17.2	38.3
10	OUAT-2*	71	111	20.4	35.2
11	VR708	50	90	17.0	31.8
12	BM-1	57	91	13.5	26.8
13	GPU-28	70	116	09.6	29.1
14	GNN-7	83	120	13.5	27.8
			SEm±	0.81	1.20
			CD at 5%	2.36	3.50
			CV%	8.3	6.0

Varietal differences for grain and fodder yield were highly significant. Two notable issues are: With the release of BBM-10 as Birsa Marua-3, the state has got a substitute for long ruling Variety A404.

We require an early maturity variety in the wake of abiotic stress. Presently, VR-708 is with us but need is to screen few more. GPU-67 has a good compromise of grain as also for fodder yield.

5. **Significant Research Highlights in other disciplines**

(i) Agronomy

Finger Millet

- I. **Seed palleting with biofertilizer and micronutrients:** On the basis of four years experiment it can be concluded that application of 100 percent recommended dose (50:40:25 kg/ha N:P:K) of fertilizer along with micro nutrients Zinc(12.5 kg/ha) & Boron (5 kg/ha), FYM (2.5 tones/ha) and seed dressing with bio fertilizers @ 3grams/kg seed was the best option to sustain soil health and yield maximization for poor soils of Jharkhand.
- II. **Chemical weed control :** Two years experiment result revealed that conventional method i.e. two Inter cultivation and one hand weeding was economically the best method for controlling weeds. But chemical weed control with Isoproteuron @ 0.5 kg a.i. /ha combined with one Inter cultivation at 40-45 days after (DAS) was economically suitable for controlling weeds.
- III. **Crop establishment under rainfed condition:** Six years data indicates that SRI method of transplanting i.e. 15 days old seedling and one seedling per hill was the best method of crop establishment for enhancing productivity and yield maximization for transplanted finger millet.
- IV. **Conservation farming :** From the four years data it can be concluded that sowing of finger millet after summer ploughing is the best method to conserve moisture for better germination and initial growth of the crop. Among different cultural practices combination of all cultural practices viz. opening of conservation furrows between 4 rows, mulching with crop residues, weed control through weedicide application and rotation with pigeon pea and rotation with pigeon pea was found to be the best for maximizing the yield under rainfed condition of Jharkhand

Little Millet

- I. **Sequence cropping :** Sequence cropping of little millet in early kharif followed by pulses/ oilseeds viz. ,horse gram, black gram, lentil, Niger ,linseed ,toria & little millet + pigeon pea (4:2) inter-cropping and fallow were evaluated. Three years data revealed that inter-cropping of little millet and pigeon pea in 4:2 row proportion followed by pigeon pea was the best cropping sequence for Jharkhand.
- II. **Conservation farming:** From the four years experiment it can be concluded that conventional tillage and one summer ploughing with mould board was the best option to conserve moisture. Among the different cultural practices combinations of all the cultural practices viz. opening a conservation furrow at every 4 rows, mulching of crop residues, weed control through weedicide application and following rotation with pigeon pea was found to be the best for maximizing the yield under rainfed condition of Jharkhand.

(ii) Pathology

Finger millet

- I. **Survey :** Blast remained a major production constraints in Farmer's field who grow their local varieties whereas A404 and BBM-10 were free from Neck and Finger blast.
- II. **Screening Trial :** Out of 23 entries tested only two test entries BR 14-3 & VL 386 recorded highly resistant reaction whereas five Test entries GPU 93, GPU 94, KOPM 942 , KMR 630, VL 352 and GPU 45(national check) sowed resistant reaction. Four test entries BR 14-3, KRI-009-04, PR 10-35, KMR 630 and VL 352, PR 202, GPU 45 (national checks) were free from banded blight infection.
- III. **Little millet**
- IV. **Screening Trial :** Out of 35 entries Screened under Advanced varietal trial and Donor screening Nursery trial , test entries RLM 238, DHLT 28-4, RLM-192, RLM-209, RLM-223 & TNAU-178 and national check JK 8 were free from banded blight incidence.
- V. **Management Trial:** Eco friendly management trial for banded blight disease resulted that soil application of value added *Pseudomonas fluorescens* + *Trichoderma viride* + *Bacillus subtilis* 335g each of talc formulation mixed in 25 kg FYM or vermicompost incubated for 15 days applied at the time of sowing recorded least banded blight incidence with highest grain yield.

Foxtail millet

Screening Trial: Out of 12 entries tested only three entries DHFTMV-2, DHFT 5-6 and DHFT 77-3 and SiA 3156 (national check) recorded least leaf blast incidence whereas only two test entries DHFTMV-2, SiA 3205 recorded resistant reaction against banded blight disease.

Curricular Programme

Studies on Small Millets isolates of *Pyricularia grisea* and its Eco- friendly Management on Finger Millet: Studies were carried out on cultural, morphological and pathological variation on *Pyricularia grisea* isolates collected from four different small millets viz., Finger millet, Proso millet, Little millet and Foxtail and its eco-friendly management on finger millet through botanicals, biocontrol agents and through identification of host-plant resistance. Variation in colony characteristics viz., growth type, pigmentation, colour of the vegetative growth, and surface appearance among the isolates of *M. grisea* from different hosts resulted in colony growth of *P. grisea* isolates significantly different in different media. Maximum radial growth was recorded in finger millet isolates and minimum was in little millet isolate.

(iii) Entomology

Finger millet

- i. **Survey:** Low incidence of Grass hopper, Aphid, *Myloccerus* weevil & Ear head caterpillar. Two natural enemies recorded were Coccinellid and Syrphid.
- ii. **Seasonal Incidence:** In all the dates of sowing upto 15 August low incidence of all the major pest was noticed. Crop did not germinate beyond 15th August.
- iii. **Screening Trial :** Out of 23 entries, GPU94, PR10-35, VL 386 were found to be free from the major pests.

Little millet

- i. **Screening Trial :** Out of 14 entries, Screened only four test entries OLM 203, DLM 95, DHLT 28-4 and JK 8 showed moderately resistant reaction.
- ii. **Management Trial:** Under integrated management of shoot fly trial, out of the eight treatment including untreated control, Treatment T3 (Spraying of 1500 ppm neem/ Azadirachtin at 15 DAS) recorded comparatively low incidence of shoot fly and maximum grain yield.
- iii. **Kodo millet**
- iv. **Screening Trial :** Out of 09 entries tested, only two test entry BK48 and TNPSC 176 showed moderately resistant reaction against shoot fly.

Proso Millet

Screening Trial : All the ten test entries were found susceptible against shoot fly.

Management Trial: Out of 08 treatment including control, none of the treatments could provide effective control of shoot fly.

7. FLD's

- (a) Improved Varieties to be demonstrated under FLDs through AICRP (SM) in Finger millet were 15 hectares during Kharif 2016.

8. Publications

(i) International

- Anita Pande, Sobha Singh, Jyoti Samad, Kumar Saurabh and Z.A. Haider (2015) Studies on Potential of finger millet (*Eleusine coracana* Gaertn. L.) amylases for Industrial applications. *Intl. J Biotech.* 4(4): 20-29.

(ii) Seminars /Conference

- Anita Pande, Summi Dutta and Z.A. Haider (2016) Endophytes of Finger millet (*Eleusine coracana* Gaertn) In : Proc. Intl. Conf. Indian Ecol. Soc. On Natural Resource Management: Ecological Perspectives. SKU&AT, Jammu, India 18-20 February, 2016. Vol 1: 304.

- Z.A. Haider (2016) Crops for Food security under unstable and unpredictable weather conditions. In : "Workshop on Climate Resilient cropping systems for East India Plateau" , 10-11 March 2016. Pp35. Organized jointly by PRADAN and Birsa Agricultural University, Ranchi.
- Z.A. Haider (2016) " Indian Agriculture - *Kal, Aaj aur Ka*". In Natl. Seminar on " Innovative Breeding approaches for Agricultural Security". March 13-14, 2016 pp9. Organized by ISG&PB, Ranchi Chapter at Birsa Agricultural University, Ranchi.
- One poster Presentation on "Chemical weed Management in Direct Sown Finger millet" in 4th International Agronomy conference held at IARI New Delhi from 22 November to 26 November 2016

(iii) **Brochures/Pamphlets**

- i. Jharkhand mein Marua ki Vagyanic Kheti
- ii. Jharkhand mein Gundli ki Vagyanic Kheti
- iii. झारखंड में अदभुत एवं अलौकिक मोटे अनाज की खेती को प्रोत्साहन : Pathari Krishi Published by BAU Kanke, Ranchi.

9. Any other activities

(a) **Seed production:** Following quantity of TL seeds was produced for the farmers as a usual practice in the project:

- **Finger millet**

(i)	A404	-	412 kg
(ii)	BM3 (BBM10)	-	103 kg
(iii)	JWM-1	-	24 kg
(iv)	BM-2	-	33 kg
(v)	VL-149	-	30 kg
(vi)	VR-708	-	14 kg
 - **Little millet**

(i)	BG-1	-	1.5+40 kg
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 - Seed distribution of finger millet improved varieties (A404 & BBM -10) was also done among 14 farmers in Bero Block (A404 - 17.5 kg; BBM -10 - 12 kg) while BBM-10 (18 kg) and A404 (10 kg) among the 12 farmers in Angara Block of Ranchi District for the popularization of BBM-10 & A404 in these traditional finger millet growing area.
 - **ITK:** Formers of Hochar village under Kanke Block use to practice placing of Little millet straw at the entry point of irrigation water in rice field which they claim to decline the incidence of rice case worm. Spraying of 5% well rotten bamboo spouts (Karial) check Shoot fly incidence in little millet crop.
- (b) **Collaboration:** The Small millets team for the last 4 years is associated with JEEVAN HOSPITAL, Satbarwa, Plamau in their nutritional Security Programme. To achieve it, we have been promoting finger millet in this non-traditional area, through trainings, Krishi goshties , field visits during the crop season, uses of finger millet in different food items.

14.Rewa

Mandate crops : Kodo millet and Little millet

Area, Production and productivity: Madhya Pradesh has the largest area under kodo millet (143.43 thousand ha) followed by little millet (51.54 thousand ha) and barnyard millet (11.76 thousand ha). Other small millets namely finger millet and foxtail millet are grown in 0.34 thousand ha and 0.13 thousand ha, respectively. Productivity of kodo millet and little millet was reported 524 kg/ha followed by 423 kg/ha in finger millet, 298 kg/ha in barnyard millet and 260 kg/ha in foxtail millet during 2013-14

Total rainfall received during the year : Total rainfall (mm):1269.0 , Rainy days :39

Significant achievements of the centre in brief during the year

One variety of kodo millet namely JK 137 has been released and notified for rainfed areas of M.P. (102(E)13.1.2016 SR) and another variety of little millet namely JK 4 has been released and notified for rainfed areas of M.P. (Recommended for notification in 75th CVRC (Sl. No. 153)

Research on Breeding (Crop-wise)

Germplasm maintained, collected, evaluated and use in breeding: Nil

xvi. Contribution of breeding materials in AICRP testing

Crop	No.	Name
Kodo millet	01	RK 64
Little millet	01	RLM 238
Barnyard millet	01	RBM 44
Foxtail millet	01	RFM 68

xvii. Development of breeding materials including crossing programme, no of crosses/progenies in various segregating generations

Foxtail millet: In F₂ generation, 15 crosses were planted and 50 superior plants which showed better yield contributing characters were selected and fifteen new crosses were attempted.

Mutation Breeding in Kodo millet and Little millet: In M₃ generation of both kodo millet and little millet 50 single plant were selected and their progenies will be evaluated in M₄ generation.

Breeder seed production programme : A total of 248 kg breeder seed of kodo millet, varieties *i.e.* JK 65 (48.50kg) and JK 439 (177.50 kg) and 22.00 kg of little millet variety JK 36 were produced during 2016-17.

Crop	Variety	Quantity (kg)
Kodo millet	JK 65	48.50
	JK 439	177.50
Little millet	JK 36	22.00
	TOTAL	248.00

Maintenance breeding of kodo millet varieties (2016-17): Fifteen kodo millet varieties namely JK 13, JK 155, JK 65, JK 136, JK 76, JK 106, JK 439, JK 48, JK 41, GPUK 3, JK 98, JNK 101, JNK 364, RK 137 and Niwas 1 and one superior culture namely RK 390-25 were maintained by growing Single Plant Selection. The following quantity of nucleus seed of released variety was produced during 2016-17.

Cultivar	Quantity (kg)	S. No.	Cultivar	Quantity (kg)
JK 41	3.50	9	RK 390-25	3.00
JK 48	2.10	10	RK 137	4.00
JK 136	3.50	11	JK 439	3.50

JK 155	2.90	12	GPUK 3	2.50
JK 76	3.10	13	JK 98	3.50
JK 65	3.80	14	JNK 101	3.50
JK 13	3.20	15	JNK 364	2.80
JK 106	2.80	16	Niwas 1	3.00

- i. Registration of genetic stocks : Nil
 ii. Coordinated trials : Mention the allotted no and conducted
 Allotted : 05 Conducted : 05

Multilocation Little millet trial (MLT)

Si. No	Entries	Plant height (cm)	No. Of productive tillers / plant	Days to 50 % flowering	Days to maturity	Grain yield (q / ha)	Fodder yield (t / ha)
1.	MLT-1	128.5	3	51	84	11.73	12.96
2.	MLT-2	147.5	3	51	82	8.95	12.04
3.	MLT-3	131.7	3	55	89	12.35	10.49
4.	MLT-4	148.1	3	67	101	10.49	12.04
5.	MLT-5	145.9	3	65	98	8.33	13.27
6.	MLT-6	147.1	3	62	81	15.87	11.11
7.	MLT-7	121.3	3	52	86	11.42	13.46
8.	MLT-8	123.8	3	52	87	10.80	11.42
9.	MLT-9	111.5	3	44	77	15.12	8.03
10.	MLT-10	150.4	3	67	103	12.78	14.38
11.	MLT-11	117.9	3	51	86	10.49	11.73
12.	MLT-12	127.3	3	51	83	14.51	15.12
13.	MLT-13	137.6	3	47	81	13.70	12.35
14.	OLM 203 (NC)	143.1	3	104	137	11.11	9.57
20.	JK 8 (NC)	108.2	4	32	62	13.58	13.58
	Mean	132.7	3	57	89	12.08	12.10
	SEm±					1.41	
	CD (5%)					4.03	
	CV(%)					20.12	

i. Station trials at the centre

1. Advance Station Varietal Trial on Kodo millet (ASVT-Kodo): The trial comprising of 10 entries including National checks TNAU 86 and RK 390-25 were evaluated for yield and yield attributing characters. Maturity period varied from 84 (RPS 700) to 101 days in RPS-691. Highest grain yield was recorded in RPS 694 (35.81 q/ha) followed by RK 390-25 (32.10 q/ha), RPS 520 (31.79 q/ha), RPS 1004 (31.48 q/ha) and RPS 691 (30.25).

Performance of kodo millet cultures in Advance Station Varietal Trial

S. No	Cultures	Plant height (cm)	Tillers/ plant	Ear length (cm)	Days to flowering	Days to maturity	Fodder yield (t/ha)	Grain yield (q/ha)	Rank
1	RPS-520	64.33	3	7.80	66	96	6.48	31.79	3
2	RPS-694	61.73	4	8.20	65	96	8.33	35.81	1
3	RPS-691	58.00	4	7.87	69	101	6.48	30.25	5
4	RPS-716	68.07	5	8.20	60	90	8.33	29.63	
5	RPS-752	57.53	6	8.60	62	95	5.86	26.55	
6	RPS-905	59.60	6	8.67	65	95	4.63	29.63	
7	RPS-700	43.00	3	7.07	53	84	4.94	28.09	
8	RPS-1004	62.33	6	8.87	63	92	5.56	31.48	4

9	RK 390-25**	61.87	4	8.87	59	89	6.33	32.10	2
10	TNAU-86**	63.07	5	10.13	69	99	6.31	22.84	
	Mean							29.82	
	SEm±							2.24	
	CD (5%)							6.44	
	CV (%)							13.05	

** National check, *Local check

2. Advance Station Varietal Trial on Barnyard millet (ASVT-Barnyard millet):

Ten genotypes of Barnyard millet including two National checks were evaluated for their yield performance. All the entries matured in between 65 days (RBM 50) to 75 days (VL 172). Highest grain yield was recorded in RBM 36 (25.31 q/ha) followed by RBM 70 (22.22 q/ha), RBM 73 (21.92 q/ha), VL 207 (20.99 q/ha) and VL 172 (20.37 q/ha). Fodder yield ranged from 8.40 (RBM 73) to 12.96 t/ha (RBM 36).

Performance of barnyard millet cultures in advanced station varietal trial

S. No	Cultures	Plant height (cm)	Tillers/plant	Ear length (cm)	Days to 50% flowering	Days to maturity	Fodder yield (t/ha)	Grain yield (q/ha)	Rank
1	RBM 73	114.33	1	18.33	40	70	8.40	21.92	3
2	RBM 59	136.20	1	19.13	42	72	12.66	19.14	
3	RBM 50	102.33	1	14.40	36	65	9.88	19.51	
4	RBM 70	139.13	1	22.13	43	73	11.48	22.22	2
5	RBM 36	119.00	1	18.27	39	69	12.96	25.31	1
6	RBM 132	98.40	1	14.07	36	67	9.26	14.82	
7	RBM 133	115.00	1	16.27	37	67	9.63	16.67	
8	RBM 134	100.80	1	13.27	36	66	11.11	12.96	
9	VL 207**	139.40	1	18.93	42	73	9.57	20.99	4
10	VL 172**	126.67	1	18.60	43	75	9.88	20.37	5
	Mean							19.39	
	SEm±							1.48	
	CD (5%)							4.27	
	CV (%)							13.28	

** National check,

3. Advance Station Varietal Trial on Little millet (ASVT-Little millet):

In little millet trial, ten entries were evaluated with one National checks and one local check for their yield performance. Maturity period varied from 67 (JK 4) to 83 days in RLM 1368. Highest grain yield was recorded in RLM 1367 (16.79 q/ha) followed by RLM 37 (16.67 q/ha), JK 4 (16.05 q/ha), RLM 190 (14.94 q/ha) and JK 8 (13.70 q/ha).

Performance of little millet cultures in advanced station varietal trial

S. No	Cultures	Plant height (cm)	Tillers/plant	Ear length (cm)	Days to 50% flowering	Days to maturity	Fodder yield (t/ha)	Grain yield (q/ha)	Rank
1	RLM-37	88.87	2	22.33	40	73	10.19	16.67	2
2	RLM-203	94.93	2	22.67	41	74	9.26	12.66	
3	RLM-190	99.00	2	20.67	43	80	12.04	14.94	4
4	RLM-1367	92.87	4	19.73	37	72	13.89	16.79	1
5	RLM-224	80.67	2	17.8	38	73	9.88	12.78	
6	RLM-1368	99.53	2	28.00	49	83	9.38	9.57	
7	RLM-1369	88.87	2	18.27	39	74	9.26	10.49	
8	RLM-1370	91.27	2	19.00	39	74	9.57	9.88	
9	JK 8**	99.67	2	22.87	39	73	12.04	13.70	5
10	JK 4*	104.4	4	26.07	37	67	13.27	16.05	3

Mean								13.35	
SEm±								1.13	
CD (5%)								3.26	
CV (%)								14.69	

** National check, *Local check

Significant Research highlights in other disciplines (Agronomy/Pathology/Entomology) in brief (any new production technology, identification of resistant/tolerant lines for major diseases and insect-pests etc.)

Identification of resistant sources against important diseases

Crop	Disease	Resistant sources
Kodo millet	Sheath blight	KOPM 8, 10, 24, BK 5, 34, JK 137
	<i>Striga asiatica</i>	RPS 744, 525, 927, 630, 852, TNAU 141
Little millet	Sheath blight	RLM 203, 175, 208, JK 4, TNAU 176, 178, OLM 203
Foxtail millet	Blast + sheath blight	SiA 3274, 3307, 3310, 3312, 3314, 4155, 4154

FLD's : Kodo millet Allotted – 15 ha Conducted : 15 ha
 Little millet Allotted – 15 ha Conducted : 5.4 ha

Publications:

National : 08

- Gupta, D.K., Jain, A. K. and Kumar, A. (2016). Evaluation of finger millet genotypes for partial resistance to leaf blast caused by *Pyricularia grisea*. *Electronic Journal of Plant Breeding*. 7(4):939-946
- Jain, A. K. , Tripathi, S. K. , Kumar, A. and Joshi, R. P. (2016). *Diagnosis and management of little millet diseases*. In *Integrated Management of Crop Diseases*. (Eds.) A. K. Tripathi, S. K. Tripathi and U. K. Khare. Aavishkar Publishers, Jaipur. pp 63-71
- Jain, A. K., Nemade, J., Kumar, A. and Tripathi, S. K. (2016). Effect of head smut on morphology and growth parameters of kodo millet (*Paspalum scrobiculatum* L.) cultivars. *Indian Phytopath.*69(4S):260-265
- Kumar, A., Jain, A. K. and Lal, N. 92017). Efficacy of *Trichoderma* and agrochemical against grain smut of little millet (*Macalpinomyces sharmae*). *Trends in Biosciences*. 10(6):1422-1425
- Mahajan, G. (2016). Effect of kodo millet (*Paspalum scrobiculatum*) based intercropping system on yield and economics of kodo millet under rainfed conditions. *New Agriculturist*. 27(1):121-124
- Mahajan, G., Tekam, Pushplata and Singh, Divya (2017). Response of kodo millet varieties to different fertility levels under rainfed conditions of Kymore plateau. *Environment and Ecology*. 35(2B):1018-1021
- Nagaraja, A., Kumar, B., Jain, A. K. and Sabalpara, A. N. (2016). Emerging diseases : Need for focused research in small millets. *J. Mycopathol. Res*. 54(1):1-9
- Tripathi, Preeti, Mahajan, G. and Tiwari, R. K. (2016). Effect of different methods of crop establishment and weed control measures on little millet (*Panicum sumatrense*) under rainfed condition. *The Bioscan*.11(3):1633-1636

Papers in seminars/conferences: 06

- Kumar, A., Jain, A. K. and Bagri, P. K. (2016). Studies on grain smut of little millet (*Panicum sumatrense* Roth ex Roemer & Schultes) caused by *Macalpinomyces sharmae* K. Vanky. In Nat. Symp. on Eco-Friendly Approaches for Plant Disease Management: Recent Trends and Opportunities organized at ICAR IIPR, Kanpur (UP) on 29-30 Dec., 2016
- Dhurwey, B., Mahajan, G., and Tiwari, R.K., Effect of crop establishment methods and weed control measure on growth and yield of kodo millet (*Paspalum scrobiculatum*), In: National convention on challenges in Indian agriculture & future strategies for sustainability held from 13th – 14th February, 2016 at Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, M,P, Pp- 21,

3. Tripathi, P., Mahajan, G., and Tiwari, R.K., Effect of crop establishment methods and weed control measures on growth and yield of little millet (*Panicum sumatrense*). In: National convention on challenges in Indian agriculture & future strategies for sustainability held from 13th – 14th February, 2016 at Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, M.P, Pp- 21,
4. Sahu, S., Mahajan, G., and Singh, D., Effect of tillage and cultural practices on yield attributes and yield little millet (*Panicum sumatrense*). In: National convention on challenges in Indian agriculture & future strategies for sustainability held from 13th – 14th February, 2016 at Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, M.P, Pp- 21,
5. Mahajan, G., Singh, D., Joshi R.P., and Jain A.K. Effect of tillage and cultural practices on productivity of little millet (*Panicum sumatrense*) for sustaining agricultural productivity under rainfed conditions . In: National Conference on “Emerging trends in Agricultural Sciences and its impact on Sustainable livelihood” held from 23rd – 28th February 2017 at Shobhit University, Meerut, UP
6. Mahajan, G. and Singh, D., Productivity of Kodo millet (*Paspalum scrobiculatum*) as affected by different dates of sowing and plant population under rainfed conditions. In the Fourth International Agronomy Congress on “Agronomy for Sustainable Management of Natural Resources, Environment, Energy and Livelihood Security to Achieve Zero Hunger Challenge”, at ICAR-IARI, Pusa Campus, New Delhi, India from November 22–26, 2016.

Brochures/pamphlets : 04 (Hindi)

1. Jain, A. K. and Joshi, R. P. (2016). *Laghu Dhanya Fasalon Ke Aushadhiya Gun*. College of Agriculture, Rewa (M.P.) pp 1-2
2. Jain, A. K. and Joshi, R. P. (2016). *Laghu Dhanya Fasalon Mein Paudh Sanrakshan*. College of Agriculture, Rewa (M.P.) pp 1-4
3. Joshi, R. P., Jain, A. K. and Chauhan, S. S. (2016). *Madhya Pradesh Ke Liye Laghu Dhanya Fasalon Kee Unnatshel Prajatiyan*. College of Agriculture, Rewa (M.P.) pp 1-4
4. Mahajan, G., Joshi, R. P. and Jain, A. K. (2016). *Madhya Pradesh Ke Liye Laghu Dhanya Fasalon Kee Unnat Utapadan Takneek*. College of Agriculture, Rewa (M.P.) pp 1-4

Awards if any : 02

1. Dr Gaurav Mahajan, Scientist (Agronomy) has been awarded with Best Scientist (Research) Award in National Conference on “Emerging trends in Agricultural Sciences and its impact on Sustainable livelihood” held from 23rd – 28th February 2017 at Shobhit University, Meerut, UP.
2. Dr Gaurav Mahajan, Scientist (Agronomy) has presented poster on title, “Effect of tillage and cultural practices on productivity of little millet (*Panicum sumatrense*) for sustaining agricultural productivity under rainfed conditions” and was awarded with third price in poster presentation.

Any other activities: Exhibits of small millets were displayed in the farmers day, Jila Rojgar sammelan and lectures were delivered in different training programmes

15. Vizianagaram

1. **Name of centre:** Agricultural Research Station, Vizianagaram, Andhra Pradesh.

Mandate crops: Finger millet and other small millets

2. **Area, Production and productivity:** In the state of undivided Andhra Pradesh, finger millet has been growing in an area of 0.29L.ha. with 0.03L.tonnes production and 951kg/ha productivity.

3. **Total rainfall received during the year:** 1194.4mm

4. **Significant achievements of the centre in brief during the year:**

- VR 900 in the name of Vegavathi is under proposal for release at state level.
- Agricultural Research Station has got “**BEST RESEARCH STATION AWARD**” for 2014-15 from Acharya N.G. Ranga Agricultural University on 4th December, 2016 at RARS, Nandyal.

5. Research on Breeding

Germplasm maintained, collected, evaluated and use in breeding:

Maintained: 3265 accessions of finger millet

Collected: 26 entries in finger millet and 11 entries in little millet

Evaluated: 1000 accessions of finger millet evaluated

Use in Plant Breeding: We are proposing to test the combining ability of ten entries (IC0476937, IC0476838, IC0477030, IC046901, IC0477340-X, IC0476586, IC0476855, IC0587992, IC0476567 AND GEC295) as lines with four testers (VL 352, VL 379, VR 708, VR 900) in Line × Tester design

xviii. Contribution of breeding materials in AICRP testing

S.No.	Year	Entries contributed to IVT	All India Rank position	Promoted to AVT
1	2014	VR 1076	9	Promoted to AVT III
2	2015	VR 1081	3	-
3	2016	VR 1094	2	

xix. Development of breeding materials including crossing programme, no of crosses/progenies in various segregating generations in tabular form

S.No.	Crosses	Generation	No. of progenies
1	VR 708 × VL 149		Cross attempted
2	GPU 67 × VR 900		Cross attempted
3	VR 847 × VL 352		Cross attempted
4	PR 202 × VR 900	F ₄	43
5	Hima × IE 3363	F ₄	62
6	IE 4708 × IE 6652	F ₄	48
7	<i>Udara malliga</i> × GPU 48	F ₇	19
8	VR 708 × GPU 48	F ₇	21
9	PR 202 × GPU 48	F ₇	37
10	KMR 252 × GPU 28	F ₇	28
11	GPU 26 × Sel.14	F ₇	7

xx. Nucleus and breeder seed programme (tabular form)

Nucleus seed production during *rabi*, 2016-17:

S.No	Variety	Production (kg)
1	VR 847 (Sri Chaitanya)	37.21
2	VR 762 (Bharathi)	12.18
3	VR 936 (Hima)	13.24

4	VR 900	3.77
5	VR 708	6.13
	Total	72.53

Breeder Seed Production during 2015-16 and 2016-17:

S.No	Variety	2015-16 (Q)	2016-17 (Q)
1	Sri Chaitanya (VR 847)	20.25	116.0
2	Bharathi (VR 762)	49.13	7.62
3	Champavathi (VR 708)	4.10	5.0
4	Hima (VR 936)	-	5.0
5.	VR-900	30.02	-
	Total	103.50	133.62

- xxi. Registration of genetic stocks: VR-900 with National Identity Number- IC 612242 from NBPGR.
- xxii. Coordinated trials :Alloted:8
Conducted:8
- xxiii. Multi-location Trials in your state (results and table):

S.No	Title	Results in brief
1.	Multi Location Yield Trial (MLT) – Finger millet	Among 10 entries, MLT-6 (38.28 q/ha) recorded highest grain yield followed by MLT-4 (36.83 q/ha), MLT-5 (35.74 q/ha) and MLT-3 (33.93 q/ha).
2.	Multi Location Yield Trial (MLT) - Foxtail millet	Among six entries evaluated, MLT-Fx-6 (32.24 q/ha) was observed to be the highest yielder followed by MLT-Fx-5 (31.81 q/ha) and MLT-Fx-2 (29.78 q/ha).
3.	Multi Location Yield Trial (MLT) - Little millet	Among thirteen entries tested LM-289 topped in grain yield with an average of 21.26 q/ha, followed by LM-73 (16.85 q/ha), LM-95 (16.18 q/ha) and LM-512 (15.93 q/ha), while checks, Pedda Sama and VS 11 recorded 14.71 and 7.69 q/ha grain yield respectively.
4.	Multi Location Yield Trial (MLT) - Pearl millet	Ten entries were tested during <i>kharif</i> season. The mean grain yield was 32.31 q/ha. PM-4 (39.67 q/ha) and PM-6 (38.25 q/ha) were highest grain yielders.

xxiv. Station trials at the centre(results and table) in brief:

Preliminary Yield Trial (PYT) – Among Nineteen entries including three checks, VR 1112 (39.20 q/ha) was observed to be the highest yielder, followed by VR 1118 (38.03 q/ha), VR 1110 (36.95 q/ha), VR 1106 (35.30 q/ha) and VR 1116 (34.91 q/ha) while checks VR 900, VR 847 and VR 708 recorded 33.27, 29.99 and 24.81 q/ha respectively.

Advanced Yield Trial (AYT)- Among nine entries tested with three local checks, highest grain yielder was VR 1099 (39.74 q/ha) followed by VR 1101 (39.62 q/ha). Local checks VR 900, VR 847 and VR 708 recorded 36.06, 30.94 and 22.12 q/ha respectively.

6. Significant Research highlights in other disciplines:

Plant pathology:

Identification of new diseases in finger millet:

- Identified Smut disease on Ragi variety TNAU-1016 and characterized the Species as *Melanopschium eleusinis* and the culture was deposited at *Indian type culture collection*, IARI, New Delhi with HCIO No. 46,921.
- Identified Rust disease on Ragi variety HR-374 and characterized the Species as *Uromyces eragrostidis* and the culture was deposited at *Indian type culture collection*, IARI, New Delhi with HCIO No. 46,915.
- Identified Banded blight disease on Ragi variety KM-252 and characterized the Species as *Rhizoctonia solani* and the culture was deposited at *Indian type culture collection*, IARI, New Delhi with HCIO No.46,916.
- Identified Tar spot disease on Ragi variety PES -400 and characterized the Species as *Phyllochora eleusinis* and the culture was deposited at *Indian type culture collection*, IARI, New Delhi with HCIO No.46,925.
- First time in the world Characterized a new virus on local variety of Ragi as *Bacilliform double stranded DNA virus*(poty group) at Advanced Center for Plant Virology, IARI, New Delhi.

In addition to this, following trials have been taken up in the station.

1. In a survey conducted in NC zone of AP for blast disease in finger millet, highest neck (12.05%) and finger blast (15.64%) were recorded at Rambilli(Visakhapatnam) followed by Parvathipuram (Vizianagaram).
2. In IVT Ragi, the lowest incidence of neck blast (7.15%) and finger blast (10.13%) were recorded in GPU 93 and GPU 94 respectively and lowest sheath blight intensity was recorded in VL 503 (11.33%) followed by GPU 94 (11.67%).
3. In AVT I & II of ragi, the lowest intensity of neck blast (14.82%) and sheath blight (32.00%) was recorded in VL 379 and finger blast (13.70%) in GPU 45.
4. DSN of FM for sheath blight among 28 entries, the lowest disease intensity (47.33%) was recorded in SiA 3212 followed by SiA 3159 (52.67%).
5. In FAVT, among 13 entries tested the lowest disease severity (40.00%) was recorded in H-46.
6. In DSN BM 1 and 2, seven and eleven entries were screened for sheath blight in which all entries has recorded maximum disease intensity.
7. In DSN LM1 and DSN LM2, among 22 and 11 entries tested, TNAU-178(37.33%) and TNPSu 207(19.33%) showed minimum sheath blight severity.
8. In LAVT, among 15 entries screened against sheath blight, the lowest disease intensity (40.00%) was recorded in BL 150.
9. In DSN PM Among 11 entries screened against sheath blight along with the check, lowest sheath blight intensity (24.00%) was recorded in DSN PM-6.
10. In PAVT, among eleven entries screened for sheath blight, the lowest disease intensity (64.00%) was recorded in TNAU 145.
11. In Eco-friendly management of banded blight in six small millets, significantly the lowest sheath blight severity (28.21%) has been recorded in the treatment Soil application of value added *P.flourescens* + *T. viride* + *B. subtilis*.

Agronomy:

1. Grain yield (2204 kg/ha) and straw yield (6308 kg/ha) were significantly high in 125% RDF compared to 100%, 75% and 50% RDF. Among pre release varieties, grain yield of VL-379(2037 kg/ha) is significantly high and it was on par with VL-352(1989 kg/ha) and national check variety VR-708(1959 kg/ha).
1. 2. Among different finger millet based intercropping systems, Finger millet+Bhendi(8:2) has recorded significantly high finger millet equivalent yield(6721 kg/ha), net returns(Rs.118926.00) and Benefit cost ratio(4.11).
2. Pre emergence application of Isoproturon@0.5kg a.i/ha and Bensulfuron methyl + Pretilachlor @ 0.198 kg a.i/ha (3 kg commercial product) have been recorded highest weed control efficiency at 20DAS. At 40DAS, Pre emergence application of Isoproturon @ 0.5 kg a.i/ha + one inter cultivation at 25-30DAS gave highest weed control efficiency(96.4%) and it was on par with two inter cultivations at 20DAS and 40DAS (96.3%). Grain and straw yields were significantly high in treatments having pre emergence application of herbicides along with one inter cultivation at 30DAS.

Plant physiology:

In Zinc bio-fortification studies in finger millet, soil and foliar application of ZnSO₄ @ 12.5 kg/ha showed a significant increase in the grain (1.88 kg/plot) and straw (2.82 kg/plot) yields.

7. CRP-AB trials, FLD's and TSPs

Name	Alloted	Conducted
CRP-AB trials	1000 lines for blast phenotyping	1000 lines for blast phenotyping
FLD's	20ha area: 10ha under Finger millet 10ha under Little millet	20ha area: 10ha under Finger millet 10ha under Little millet
TSPs	378.32ha area	274 beneficiaries in 388.32ha of area

8. Publications:

S.No	Name	Number
1.	International papers with NAAS rating above 3.5	22
2.	National papers with NAAS rating above 3.5	6
3.	Papers presented in seminars/conferences	15
4.	Chairing the sessions in International conferences	6
5.	Invited speaker in International conferences	4
6.	Books/Technical bulletins	4
7.	Brochures/pamphlets	6
8.	Awards received by the scientists of the station	15
9.	Farmers training programmes conducted	24
10.	Kisan melas participated	3
11.	Training & Visit meetings	12
12.	Agricultural Market Committee workshops attended	15

9. Any other activities:

1. Agricultural Research Station, Vizianagaram was the **centre for DUS testing** in Finger millet.
2. Received "**Innovative Scientist Award**" for paper presentation at the International conference on Innovative approaches in applied sciences and technologies (iCiAsT-2016) during February 1-5, 2016 at Faculty of Science Kasetsart University, Bangkok, Thailand
3. Also received "**Best Paper Award**" in the same conference.
4. Got "**Special Recognition Award**" for **Small millet research and overall contribution in the field of plant pathology** at the 5th International Conference on Integration of Science and Technology for Sustainable Development 2016 (5th ICIST 2016) during November 26-27, 2016 at Inle Cherry Queen Hotel, Southern Shan State, Myanmar.
5. Got **Best oral Presentation-2016**, at the 5th International Conference on Integration of Science and Technology for Sustainable Development 2016 (5th ICIST 2016) during November 26-27, 2016 at Inle Cherry Queen Hotel, Southern Shan State, Myanmar.
6. Promoted **Millet canteen and registered Farmers Producers Organizations(FPO's)** in the name of "**Arogya**" by women SHG's and inturn supplying 14,000 millet biscuits per day to district tribal hostels.
7. Testing of Maize cultivars in collaboration with – CIMMYT under "Rythu kosam project" during kharif and rabi 2016.
8. Establishment of **Millet processing and value addition unit** at ARS, Vizianagaram.

16. Waghai

1. **Name of centre and mandate crops:** Hill Millets Research Station, Waghai, Dist. Dangs working under Navsari Agricultural University, Navsari is for the small millets crops since from 1954-55. In 2014-15, ICAR has allotted the AICRP-SM at Waghai center. The small millets comprising of small seeded cereals like finger millet, little millet and kodo millet are grown in hilly tract of Dang, Valsad, Tapi, Narmada and Panchmahal districts of the south and middle Gujarat.

2. **Area, Production and productivity:** In South Gujarat, small millets cultivated over an area of 21,095 hectares during 2016-17, among them 13,515 under finger millet (Nagli / ragi) (Dangs - 7575 ha. Valsad - 4960 ha., Tapi & Narmada - 980 ha.) and 7580 ha. under Little millet (Vari) with average productivity 892 kg/ha and 820 kg/ha, respectively.

3. **Total rainfall received during the year:** The total precipitation received at Waghai was 2390.0 mm in 72 rainy days. Frequent rainfall received during the cropping period.

4. **Significant achievements of the centre in brief during the year:**

4 A. Improved varieties of Finger millet, Little millet and Kodo millet

Crop	Variety	Grain Yield (kg ha ⁻¹)	Year of Release	Special attributes
Finger millet	Guj. Navsari Nagli-7 (White)	2400-2500	2016	White seeded, bold type, Semi-Compact large ear head and Moderately resistant to blast and foot rot
Little millet	Guj. Navsari Vari-3	2700-2800	2016	Medium duration and non lodging type, Yellow grain colour, Long panicle with more number of grains and Tolerant to lodging and shattering.
Kodo millet	Guj. Kodra-3	2200-2300	2016	Medium duration, Resistance to Pest and diseases and Bold Grain Size

4 . Any major production technology developed at your centre and recommended at National or State level

- I. **Response of different varieties of finger millet (Nagli) to integrated nutrient management under rainfed condition:** The farmers of South Gujarat heavy rain fall zone I (AES-I) growing finger millet during *kharif* season are recommended to grow variety GN-5 for getting higher yield, net income and benefit : cost ratio. Further, they are advised to fertilized the crop with 75% RDF + vermicompost @ 2 t/ha.
- II. **Response of little millet (Vari) to nitrogen and phosphorus levels under rainfed condition.:** The farmers of South Gujarat heavy rain fall zone I (AES-I) growing little millet (GV-2) during *kharif* season are advised grow their crop with application of 60 kg N/ha and 40 kg P₂O₅/ha for getting higher yield, net income and benefit: cost ratio.

Pathology: Three (03) recommendations Approved during 2016-17.

- I. **Efficacy of fungicides and bioagent as seed treatment as well as foliar spray for the control of blast disease of finger millet.:** Finger millet growers of south Gujarat (AES I) are advised to treat the seed with *Pseudomonas fluorescence* (CFU- 108/ml), 10ml/kg and two sprays of *P. fluorescence* @ 6ml/l first at initiation of disease and second after 15 days after the first spray for effective management of blast.
- II. **Efficacy of fungicides and bioagent as seed treatment as well as foliar spray for the control of blast disease of finger millet:** Seed treatment with carbendazim 50 WP @ 2g/kg seed and two sprays of tricyclazole 75 WP @ 0.6g/l of water or tebuconazole 25.9 EC @ 1ml/l first immediately after the appearance of disease and second 15 days after the first spray is suggested for the management of finger millet blast.
- III. **Evaluation of finger millet (*Eleusine coracana* L. Gaertn.) germplasms for resistance to blast disease on the basis of biochemical parameter:** The finger millet genotypes/varieties viz; GN-5, GPU-28,

GPU-48, KOPN-235, KMR-204 and MR-6 having maximum amount of total phenols were found resistant to the blast disease.

5. Research on Breeding (Crop-wise)

Germplasm maintained, collected, evaluated and use in breeding

Details	Red Finger Millet	White Finger Millet	Little millet	Total Germplasm collected and maintained and use in breeding
Total accession collected	182	45	97	324

xxv. Contribution of breeding materials in AICRP testing

Name of culture	Pedigree	Nominated Trial	Year of nomination	Release culture/variety Name
WWN-220	Local selection from Dangs District	IVT, AVT-II	<i>Kharif-2006</i>	GN-4
WV-125	Selection from Mutation breeding materials developed from GV-2	IVT, AVT	<i>Kharif-2008</i>	GV-2
WWN-20	Local selection from Dangs District	IVT, AVT-I & II	<i>Kharif-2009</i>	GNN-5
WN-259	Local selection from Dangs District	IVT, AVT-III	<i>Kharif-2012, 2013</i>	GNN-6
WWN-25	Local selection from Dangs District	IVT, AVT	<i>Kharif-2013-14 & 2014-15</i>	GNN-7
WV-126	Selection from Mutation breeding materials developed from GV-2	IVT	<i>Kharif-2016</i>	--

Development of breeding materials including crossing programme, no. of crosses/progenies in various segregating generations:

Generations	No. of crosses/progenies done	Lines selected from Crosses/progenies in various segregating generations	Breeding objectives for crossing programme
F1	6	---	Blast Resistance, High yield and early to medium maturing, bold grain, drought tolerant
F2	21	7	
F3	42	13	

Nucleus and breeder seed programme

Sr. No.	Crop	Variety	Stage wise Production (kg)	
			Stage	Yield (kg)
1.	Nagli (Ragi) (Finger millet)	Guj. Nagli-4	Nucleus	2.5
			Uni. (TF)	810
		Guj. Nagli-5 (White)	Nucleus	3.5
			Uni. (TF)	305
		Guj. Nav. Nagli-6	Nucleus	5.5
			Uni. (TF)	980
		Guj. Nav. Nagli-7	Nucleus	1.5
			Uni. (TF)	95
2.	Vari (Little millet)	Guj. Vari-2	Nucleus	2.7
			Uni. (TF)	476
		Guj. Nav. Vari-3	Uni. (TF)	85

Registration of genetic stocks:

- Totally Six varieties of small millets, in which Four finger millet varieties viz., GN-4, GNN-5, GNN-6, GNN-7 and two little millet varieties viz; GV-2, GNV-3 have been registered with NBPGR, New Delhi 2.
- Three varieties of small millets, in which Two finger millet varieties viz., GNN-5, GNN-6 and one little millet variety viz; GV-2 have been send for registration with PPV & FRA, New Delhi during 2015-2016.
- Two varieties of finger millet viz., GN-5, GNN-6 and one little millet variety viz; GV-2 has been notified under Notification of released varieties during 2015-2016.

Coordinated trials : (Mention the allotted no. and conducted)

Sr. No.	Name of crop	Centers	AICSMIP No.	No. of Experiments Conducted	No. of Experiments Failed	% of success/ conducted
1.	Finger millet	Waghai	AICSMIP- IVT and AVT I & II (E & M)	2	--	100
2.	Little Millet	Waghai	AICSMIP- IVT	1	--	100
	Total			3	NIL	100

Multi-location Trials in your state and Station trials

- 1. Finger millet Large Scale Varietal Trial (LSVT I & II) early and medium group.:** The LSVT of finger millet trial comprised of fourteen genotypes with three checks among two local checks GN-4 and GNN-6 with one national check GPU-45 were evaluated at Waghai and Dahod. The treatments differed significantly among themselves for grain yield at both the locations. On average basis the highest grain yield (3033 kg/ha) was recorded by WN-550 with the grain yield advantage of 8.8 per cent and 26.2 per cent over the local check GNN-6 and GN-4, respectively and 33.6 per cent over national check GPU-45 at both locations. However, the significantly highest grain yield was recorded by the genotype WN-569, WN 544, WN 585, WN 591 and WN 548 with increase in 3.7 to 33.6 per cent over best local checks and national checks.
- 2. Finger millet Large Scale Varietal Trial (LSVT III) long duration group:** A trial comprising of fourteen late maturing genotypes of finger millet along with PR-202, GPU-67 as National check and GNN-6 as local check were evaluated at Waghai. The results revealed significant genotypic differences for grain yield. The genotype WN-559 (3282 kg/ha) gave the significantly higher grain yield over the local check GNN-6 (2938 kg/ha) and national check PR-202 (2627 kg/ha), GPU-67 (2802 kg/ha) with yield advantage of 11.71, 24.94 and 17.16 per cent, respectively.
- 3. Finger millet Small Scale Varietal Trial (SSVT) :** The trial comprising of twenty genotypes of finger millet including two national checks and two local checks were evaluated at Waghai and Dahod locations. The grain yield differences were found significant at both the locations.
- 4. Finger millet Preliminary Evaluation Trial (PET):** The PET was conducted at Waghai with a total of thirteen genotypes including two local checks viz. GN-4, GNN-6 and two national checks viz. GPU-45 and VL-149. The grain yield differences were found significant. The genotypes WN-594 (3815 kg/ha), WN-599 (3556 kg/ha), WN-603 (3864 kg/ha), WN-604 (3858 kg/ha) and WN-627 (3815 kg/ha) were found significantly superior over local check variety GNN-6 (3022 kg/ha) and national check VL-149 (2656 kg/ha) and GPU-45 (2698 kg/ha).
- 5. White Finger millet Large Scale Varietal Trial (LSVT):** The LSVT trial comprised of ten white finger millet genotypes along with national check VL-149 and local check GNN-7 were conducted at Waghai and Dahod. The grain yield differences were found significant at both the locations. At Waghai the genotypes, WWN-26 (2449 kg/ha), WWN-32 (2488 kg/ha) and WWN-35 (2803 kg/ha) was found significantly superior over local check GNN-5 (2137 kg/ha) over the yield advantages of 12.73 per cent, 14.55 per cent and 29.04 per cent respectively.
- 6. Finger millet Multilocation Trial (MLT) :** Thirteen high yielding genotypes were tested in multilocations at Waghai and Dahod. The yield differences were found significant at both the locations. On an average basis the highest grain yield was recorded by the Genotypes WN-550 (3068 kg/ha), followed by WN-544 (2772 kg/ha), WN-548 (2890 kg/ha) found to be promising on an average basis. The genotype WN-550 (3068 kg/ha) ranks first with yield advantage of 22.60%, 41.29% and 5.56% over local best checks GNN-6 and national check VL149 and GPU-67 respectively.
- 7. Little millet Large Scale Varietal Trial (LSVT) :** The trial comprised of eight genotypes, one national check variety CO-2 and a local check variety GNV-3 of the region. The genotype WV-126 (3381 kg/ha) was found superior over the local check variety GNV-3 (3167 kg/ha) by 6.8 per cent also the genotypes WV-124 (3236 kg/ha), WV-130 (3309 kg/ha) and WV-126 (3381 kg/ha) significantly superior over the national check variety CO-2 (2802 kg/ha) by 15.5, 20.7 and 18.1 per cent.

8. **Little millet Small Scale Varietal Trial (SSVT):** Small Scale Varietal Trial was conducted during *khari* -2015 comprising of eleven genotypes including one national check variety JK-8 and one local check variety GNV-3. The yield differences due to genotypes found significant. The genotypes WV-167 (3272 kg/ha) and WV-168 (3215 kg/ha) was found significantly superior over the best local check variety GNV-3 (2973 kg/ha) by 10.0 and 8.10 percent respectively. However the same genotypes were significantly superior over the national check variety JK-8 (632) by 106.5 and 102.9 per cent.
9. **Little millet Preliminary Evaluation Trial (PET):** The preliminary evaluation trial comprised of twenty three genotypes including one national check variety JK-8 and one local check variety GNV-3 were tested at Waghai. The yield differences were found significant. The genotypes WV-155 (3910 kg/ha) were recorded significantly superior over local check variety GNV-3 (3440 kg/ha) followed by WV-154 (3771 kg/ha), WV-156 (3697 kg/ha) and WV-207 (3056 kg/ha). However all the genotypes were significantly superior over the national check variety JK-8 (1117 kg/ha).
10. **Kodo millet Small Scale Varietal Trial (SSVT) :** Fourteen kodomillet genotypes along with local check GAK-3 and national check GPU-K-3 were tested at Dahod location. The experimental results were found significant for grain yield. The significantly highest grain yield were recorded by DK-150 (2215 kg/ha.) with yield advantage of 63.9% over local check GAK-3 (2058 kg/ha) and 7.6 % over national check GPU-K-3 (1351 kg/ha), respectively. Also the genotypes DK-143 and DK-161 superior over GAK-3 the local check.
11. **Kodo millet Large Scale Varietal Trial (LSVT) :** The trial comprised of twelve genotypes including GK-2 as local and GPU-K-3 as national check was evaluated at Dahod for yield and yield attributes. The results showed significant genotypic differences for grain yield. Among the genotypes, DK-151 (2387 kg/ha) and DK-159 (2457 kg/ha) recorded numerically higher grain yield which was 14.6 per cent and 18 per cent increased over local check GAK-3 (2082 kg/ha).

Best promising entries in Multilocation and Station trials in the State

Sr. No	Crop	Name of the experiment	Entries	Centre	Best genotypes with grain yield (kg/ha)	% increase over check			
						Local Check	National Check		
1	Finger millet	LSVT-I & II (E & M)	11+3	Waghai & Dahod	GNN-6 (2882)	GN-4 (2485)	GPU-45 (2347)		
					WN-544 (3033)			5.2	29.2
					WN-548 (2990)			3.7	27.4
					WN-550 (3137)			8.8	33.6
					WN-569 (3089)			7.2	31.6
					WN-585 (3020)			4.8	28.7
					WN-591 (2989)			3.7	27.3
2	Finger millet	LSVT-III (L)	11+3	Waghai	GNN-6 (2938)	GPU-67 (2802)	PR-202 (2627)		
					WN-559 (3282)			11.71	24.94
					WN- 567 (3263) WN-562 (3236)			10.14	23.18
								11.04	24.19
3	Finger millet	SSVT	16+4	Waghai & Dahod	GNN-6 (2817)	GN-4 (2646)			
					WN-586 (3107)		10.33	17.44	
					WN-587 (2993)		6.27	13.11	
					WN-593 (3144)		11.63	18.82	
					PR-202 (2055)		GPU-45 (2427)		
					WN-592 (3125)			51.25	28.07
					WN-591 (2880)			45.68	23.35
					WN-585 (2815)			53.03	29.57

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4	Finger millet	PET	10+3	Waghai	WN-594 (3815) WN-599 (3556) WN-603 (3864) WN-604 (3858) WN-627 (3815)	GNN-6 (3022) 4.1 7.4 3.5 5.9 2.3	VL-149 (2656) 18.5 22.2 17.8 20.5 16.0	GPU-45 (2698) 16.6 20.3 15.9 18.6 14.6
5	Finger millet	LSVT (White)	7+3	Waghai Dahod	WWN-26 (2449) WWN-32 (2488) WWN-35 (2803)	GNN-7 (2452) -- -- 14.34	GN-5 (2172) 12.73 14.55 29.04	VL-149 (2283) 7.27 9.00 22.80
6	Finger millet	MLT	8+5	Waghai Dahod	WWN-544 (2772) WWN-548 (2890) WWN-550 (3068)	GNN-6 (2502) 10.77 15.49 22.60	VL-149 (2171) 27.66 33.10 41.29	GPU-67 (2906) -- -- 5.56
7	Little millet	LSVT	5+3	Waghai	WV-124 (3236) WV-126 (3381) WV-130 (3309)	GNV-3 (3167) 2.2 6.8 4.5		CO-2 (2802) 15.5 20.7 18.1
8	Little millet	SSVT	8+3	Waghai	WV-167 (3272) WV-168 (3215)	GNV-3 (2973) 10.0 8.10		JK-8 (1584) 106.5 102.9
9	Little millet	PET	15+8	Waghai	WV-154 (3771) WV-155 (3910) WV-156 (3697) WV-207 (3056)	GNV-3 (3440) 9.6 13.7 7.5 7.8		JK-8 (1117) 59.0 64.9 55.9 56.3
10	Kodo millet	SSVT	11+3	Dahod	DK-143 (2112) DK-150 (2215) DK-161 (1968)	GAK-3 (2058) 56.3 63.9 45.6		GPU-K-3 (1351) -- 7.6 --
11	Kodo millet	LSVT	9+3	Dahod	DK-151 (2387) DK-159 (2457)	GAK-3 (2082) 14.6 18.0		GPU-K-3 (1584) 50.7 55.1

6. Significant Research highlights in other disciplines:

6.1 Agronomy: Two (02) recommendations Approved during 2016-17.

- I. **Response of different varieties of finger millet (Nagli) to integrated nutrient management under rainfed condition:** The farmers of South Gujarat heavy rain fall zone I (AES-I) growing finger millet during *kharif* season are recommended to grow variety GN-5 for getting higher yield, net income and benefit : cost ratio. Further, they are advised to fertilized the crop with 75% RDF + vermicompost @ 2 t/ha.
- II. **Response of little millet (Vari) to nitrogen and phosphorus levels under rainfed condition:** The farmers of South Gujarat heavy rain fall zone I (AES-I) growing little millet (GV-2) during *kharif* season are advised grow their crop with application of 60 kg N/ha and 40 kg P₂O₅/ha for getting higher yield, net income and benefit: cost ratio.

Pathology: Three (03) recommendations Approved during 2016-17.

- I. **Efficacy of fungicides and bioagent as seed treatment as well as foliar spray for the control of blast disease of finger millet:** Finger millet growers of south Gujarat (AES I) are advised to treat the seed with

Pseudomonas fluorescence (CFU- 108/ml), 10ml/kg and two sprays of *P. fluorescence* @ 6ml/l first at initiation of disease and second after 15 days after the first spray for effective management of blast.

- II. **Efficacy of fungicides and bioagent as seed treatment as well as foliar spray for the control of blast disease of finger millet:** Seed treatment with carbendazim 50 WP @ 2g/kg seed and two sprays of tricyclazole 75 WP @ 0.6g/l of water or tebuconazole 25.9 EC @ 1ml/l first immediately after the appearance of disease and second 15 days after the first spray is suggested for the management of finger millet blast.
- III. Evaluation of finger millet (*Eleusine coracana* L. Gaertn.) germplasms for resistance to blast disease on the basis of biochemical parameter: The finger millet genotypes/varieties viz; GN-5, GPU-28, GPU-48, KOPN-235, KMR-204 and MR-6 having maximum amount of total phenols were found resistant to the blast disease.

7. CRP-AB trials, FLD's and TSPs (if allotted)-mention no of trials allotted and conducted:

Demonstrations: FLD on Small millets under ICAR - AICRP - SM

No	Centre	Crop	Demonstration Area (ha.)		No. of Farmers allotted FLDs
			Assigned	Conducted	
1.	Hill Millet Research Station. Navsari Agril. University, WAGHAI(DANGS)Gujarat	Finger Millet	10.00	10.00	477
		Little Millet	5.00	5.00	288

8. Publications:

- Harshal E. Patil, J. V. Patel and P. A. Vavdiya.2016. A high yielding Little Millet variety 'GNV-3' for cultivation in south and middle Gujarat., International journal of Tropical Agriculture; 34 (6): 1403-1406
- Harshal E. Patil, J. V. Patel, P. A. Vavdiya, Yogeshkumar V. Naghera, and C. G. Intwala.2016. A high yielding white colored Finger millet variety 'GNN-7' for cultivation in south and middle Gujarat., International journal of Tropical Agriculture; 34 (6): 1407-1411
- Harshal E. Patil, P. A. Vavdiya, S. Akalade and S. S. Joshi .2016. Evaluation of vegetable type genotypes in Pigeon pea (*Cajanus cajan* (L.) for yield and yield contributing traits, J. of Agril. Sciences, 1224-1230.

ii. Brochures/Pamphlets:

Five (05) folders published in Gujarati language namely as follows.

1. Improved packages of Practices for Nagli.
2. Improved packages of Practices for little millet.
3. Value addition for Nagli and little millets.
4. Blast control method and its Practices in Nagli.
5. Use of biopesticide in small millets (Nagli and Vari) crops.

9. Other Extension activities completed during the year 2016:		No. of activities attended /conducted
1.	Agricultural Fairs / field days conducted	6
2.	Number of farmers training programme completed under Mera Gaon Mera Gaurov	8
3.	Visit of NAU Scientists under Monitoring of research trials	22
4.	Visit of PD-AICRP-SM for Monitoring of experiments	01
5.	Visit of AICRP Monitoring team	01 (Three Members)
6.	Workshop/Seminars attended (National)	01
7.	Number of Farmers Field visits programme completed under FTC, Ahwa and ATMA, Ahwa	21
8.	Number of lectures delivered during farmers training programme conducted by FTC, Ahwa and ATMA, Ahwa	12
9.	Number of lectures delivered during farmers training programme conducted by KVK, Waghai	06
10.	Number of lectures delivered during farmers training programme conducted by Forest Department, Valsad (North & South).	02
11.	Number of lectures delivered as Radio talks	02
12.	Participated in Agricultural Technology week (organized by KVK, Waghai) for small millets stall exhibition and lecture delivered	02 Places

17. Project Coordinating Unit

All India Coordinated Research Project on Small Millets, ICAR, GKV, Bengaluru

1. Germplasm maintained, collected, supplied and used in breeding programme

Sl. No.	Millets	Total No. of germplasm maintained	Exotic collections	No. of germplasm supplied
1	Finger Millet	4448	175	629
2	Kodo Millet	1410	10	76
3	Barnyard Millet	965	14	67
4	Little millet	1002	-	78
5	Proso Millet	611	106	58
6	Foxtail Millet	1747	339	225
	Total	10,183	644	1133

Germplasm Conservation: PC Unit, Small Millets is a national active germplasm site. Its main function is to collect, evaluate, conserve and supply germplasm accessions to needy scientists from different centres. We have maintained 4448, 1410, 965, 1002, 611 and 1747 of finger millet, kodo millet, barnyard millet, little millet, proso millet and foxtail millet accessions respectively. Till now supplied 1133 accession of different millets to needy researchers.

2. Contribution of breeding materials in AICRP testing

Sl. No.	Entry	Trial	Pedigree
1	GPU 94	Finger millet Initial Varietal Trial	GPU 67 X GPU 28
2	GPU 93	Finger millet Initial Varietal Trial	GPU 67 X GPU 28
3	GPUP 26	Proso millet Advanced Varietal Trial	GPMS 109 X GPUP 21
4	GPUP 25	Proso millet Advanced Varietal Trial	GPMS 109 X GPMS 908
5	GPUL 3	Little millet Advanced Varietal Trial	JK 8 x Peddasame (Purple early)

ii) Contribution of breeding material to AICRP testing during 2016-17

Crop	Entries	Remarks
Finger millet	GPU 93 & GPU 94	AICRP trials
Finger millet	GPU 93, GPU 94, GPU 95, GPU 96 & GPU 97	State Multilocation Trials
Proso millet	GPUP 25 & GPUP 26	AICRP trials
Little millet	GPUL 3	AICRP trials

iii) Development of breeding material: Finger millet: Summer 2015-16

Segregating generation F4 to F5

Cross	No. of lines tested	No. of lines selected	Remarks
GPU 28 x GPU 67	90	28	Bending angle -71.4-83°, yield 15-124 gm/pl
GPU 28 x HR 911	49	05	Plant height 86.1-125.4 cm, yield 14.5-87 gm/pl
GPU 28 x Indaf 8	48	10	Peduncle length 14.4-26.8 cm, yield 21-85 gm/pl
GPU 28 x MR 6	50	05	Peduncle length 18.7-27.56 cm, yield 16-69 gm/pl

Kharif 2016:

GPU 28 x GPU 67 28 lines tested across 3 locations (F₅ to F₆)

Result: Stem diameter- ranged from 1.3 to 2.8 cm

Bending angle- ranged from 71.4 to 81.7°

Test weight- ranged from 1.03 to 3.4 gms

Seed yield/ plant ranged from 7.0 to 27.75 gms

- (a) To transfer virescence to the existing GPU 28 variety and to test cross compatibility, the following crosses were attempted

GPU 28 x (GE-1 x GPU 67) 7-8 10 Testers
 GPU 28 x (GE-1 x GPU 67) 7-5 X KOPN 235, VL 315, L5, OEB 526,
 GPU 28 x (GE-1 x GPU 67) 18-8 CO 10, A 404, HR 911, MR 6, BM 2 and MR 1

- (b) Development of Foxtail millet Segregating material:70 plants from cross : SiA 3285 x SiA 3156 were selected and tested during kharif 2016. From this F₃ progeny, 201 plants were selected and 70 progenies advanced during summer 2016-17.

3. Development of breeding materials

a. Little millet

Sl. No.	Cross	Population	No. of lines evaluated
1	JK 8 x Peddasame purple early	P1	43
2	JK 8 x Peddasame purple early	P2	79
3	JK 8 x Peddasame purple late	P3	23

145 little millet F₅ advanced lines derived from three different populations were evaluated along with their parents for yield, height and early maturity and advanced to next generation.

b. Finger Millet

Sl. No.	Cross	Generation	No. of lines evaluated
1	PS 1 x GE 2816	F ₃	5
2	PS1 x GE 4683	F ₃	16
3	PS1 x GE 1	F ₃	15
4	PS1 x GE 4972	F ₃	10
5	PS1 x HR 911	F ₄	4
6	PS1 x GPU 67	F ₄	11
7	PS1 x MR 6	F ₄	10

F₃ generation of 46 advanced lines, 25 lines of F₄ generations of different crosses of finger millet were raised, selections were made and advanced to next generation.

- c. **Proso Millet:** Forty F₂ segregating lines of cross GPUP 8 x K1 were forwarded to F₃ generation

4. Nucleus and breeder seed programme

a. Finger millet varietal seed production

Sl. No.	Varieties	Yield (Kg)
1	GPU 67	12
2	GPU 26	10
3	GPU 48	12
4	GPU 28	12.5
5	GPU 45	10
6	ML 365	13

b. Small millets varietal seed production

CROP	Sl. No.	Varieties	Yield (Kg)
Foxtail millet	1	SiA 3085	10
	2	SiA 3088	30
	3	SiA 3156	28
Proso millet	1	GPUP 21	30
	2	TNAU 145	35
Barnyard millet	1	VL 702	30

c. Finger millet nucleus seed production

Sl. No.	Varieties	No. of ear head harvested
1	GPU 67	43
2	GPU 26	37
3	GPU 66	34
4	GPU 48	43
5	GPU 28	38
6	GPU 45	41

d. Varietal Seed Multiplication

Sl. No.	Crop	No. of Varieties (multiplied)
1	Finger millet	48
2	Foxtail millet	5
3	Proso millet	5
4	Barnyard millet	4
5	Little millet	8
6	Kodo millet	17

5. Finger millet State Multi location Trial

Sl. No.	Entries	Grain yield (kg/ha)	Fodder yield (kg/ha)	Days to 50 % flowering	Days to maturity	Main ear length (cm)	No. of fingers per ear	Plant height(cm)	No. of tillers per plant
1	GPU94	4901	11294	70	109	5	8	111	4
2	KMR316	4341	10060	59	97	5	7	104	4
3	GPU95	4541	11232	70	108	8	7	111	4
4	GPU97	5408	11664	69	106	6	8	103	4
5	KMR630	5296	8825	67	105	5	10	111	4
6	GPU93	4448	9689	74	114	7	7	95	4
7	KMR636	4871	8208	61	97	6	8	109	4
8	GPU96	4785	9628	68	104	6	8	105	4
9	KMR638	2378	9257	55	94	4	7	92	4
10	MR6(ch)	5716	11232	70	109	9	9	132	4

11	KMR204(ch)	4778	11356	60	99	5	8	105	4
12	KMR301(ch)	4294	9072	60	98	7	8	109	4
	Mean	4646	10126	65	103	6	8	107	4

This trial was conducted with elite entries including three checks MR 6, KMR 204 and KMR 301 for evaluation of yield and yield attributes. Flowering of entries ranged from 55 days (KMR 638) to 74 days (GPU 93). None of the entry recorded significant yield compared to best check MR 6 (5716 kg/ha).

Guidelines for the conduct of test for Distinctiveness, Uniformity and Stability in Small millets

Crop	No. of traits considered	Grouping characters (no.)	
Finger millet	Gazette Notification on 02/07/2015		
Foxtail millet			
Kodo millet	30	5	Published in PPV &FR journal in November 2016 for comments
Barnyard millet	23	5	
Little millet	20	5	
Proso millet	20	6	

6. Publications

Research papers (National)

- Saritha, H.S. Ravishankar. P and Aruna, Y.R.; 2016, Identification of High Yielding, Neck and Finger blast resistant and Nutrient rich white Finger millet genotypes; *Int. J. Agri. Sci. & Res*; 6(3); 2250-57
- Chandrashekar, A, Vijayanthi, P.V., Mohanrao, A, Ramesh, S, Ravishankar, P and Gowda MVC; 2016: Transferability of cross cereal species SSR markers to Finger Millet (*E. coracana* L.); *Int. J. Agri.Sci*; 8(49); 20159-62
- Chandrashekar, A, Mohanrao, A, Ramesh, S, Gowda MVC, Nagaraja, A and Ravishankar, P; 2016: Identification of resistant F6 RILs of Finger millet for neck and finger blast disease infection under natural hotspot; *Mys. J. Agri.Sci*; 50(2); 358-361
- Chandrashekar, A, Mohanrao, A, Ravishankar, P, Ramesh, S and Madhusudhan, K; 2017: Identification of high yielding and blast disease resistant F6 RILs in Finger millet; In publication in *Int. J. Agri. Sci*.
- C. Nandini, B. Sujata, M. Krishnappa and Y. R. Aruna., (2016) "Genetic variability, heritability, genetic advance and character association studies in F3 generation of cross JK 8 X Peddasame (Purple late) in little millet (*Panicum miliare* L.)" *ASSIAN JOURNAL OF BIOSCIENCE*, 11(2), 244-249.
- B. Sujata., Nandini C, Krishnappa M. and Aruna., Y. R. (2016) Inter relationship, cause-effect and variability analysis in F3 generation of cross JK8 x Peddasame (purple early) in Little millet (*Panicum miliare* L.)" *ADVANCES IN LIFE SCIENCES JOURNAL*, 5(15), 5680-5684.
- B. Sujata., C Nandini, M Krishnappa, Chandrashekhar Angadi and Prabhakar (2017) " Estimation of gene actions and character association in F3 and F4 generations of Little Millet cross JK 8 x Peddasame urple early (*Panicum miliare*)" *INTERNATIONAL JOURNAL OF AGRICULTURAL SCIENCES* , 13(1) ,119-123.
- C Nandini, B. Sujata, M. Krishnappa, Chandrashekhar Angadi and Prabhakar (2017) "Gene action, genetic parameters and association in segregating populations of two little millet (*Panicum miliare* L.) crosses" *GREEN FARMING*. 8(2): 1-6

Poster presentation

- Krishnappa M., Nandini C., Sujata Bhat and Prabhakar, (2017) "Studies on Gene action, genetic parameters and genetic association in segregating populations of two little millet (*Panicum miliare* L.) crosses" XIII Agricultural Science Congress-2017: Climate Smart Agriculture, 21-24.