



# Progress and achievements in Kharif grain Sorghum Breeding: 2019-20



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<b>Trial</b>	<b>No.</b>
Multi-location	4
Collaborative experiments	2



## **Team**

**Zone I** : Bailhongal, Bhavanisagar, Chamarajnar, Coimbatore, Dharwad, Hagari, Palem, Nandyal, Nuziveedu seeds (9)

**Zone II**: Akola, Aurangabad, Buldhana, Hytech seeds, Indore, Karad, Parbhani, Somnathpur, Virangam, Wasim, Yavatmal (10)

**Zone III**: Aseda, Deesa, Mangrol, Pali, Pratapgarh, Surat, Udaipur (7)



# Major Recommendations of 49th AGM & action taken



Recommendation	Action taken
Red sorghum has export potential. Hence there is need to conduct a trial involving colored sorghum.	A <b>trial on specialty sorghums</b> including colored sorghum genotypes was conducted with 25 genotypes
To strengthen the hybrid development program through inter-institutional hybrid program	Promising <b>MS and R lines were pooled</b> from different centres (25MS and 29R) and hybrids were developed in different possible combinations.
To give emphasis on development of early maturing hybrids	<b>7 Early MS and 7 early R</b> from Akola, Dharwad and IIMR <b>were pooled</b> and hybrids were developed. 11 of these were evaluated across 6 locations
Use of resistant sources identified in entomology and pathology trials, in breeding programme	Some stable resistant sources identified such as GMN 46, GMRP 261 and GMRP 106 for grain molds; and RSSV 9, RSV 1410, SLR 84, SLV 145 and NRCSFR 09-3 for shoot fly were involved in the crossing program.



## Significant Achievements during 2019-20



### Released 3 kharif sorghum genotypes for cultivation

- CSV 37- An early maturing variety (3700 kg/ha GY and 140 q/ha FY)- Zone II
- CSV 41- A dual purpose variety (3200 kg/ha GY and 160 q/ha FY)- Zone I
- CSV 42- Kharif grain sorghum variety (3862 kg/ha GY and 140 q/ha FY)- with CVRC

### Lines identified for registration

- Three population breeding derivatives, GM 017, GM 093 and GM 146 identified for registration with NBPGR (FGS 2.8 to 3.2 vs 2.7 of B 58586)

**CSH 14 and CSH 16, most popular hybrids were recognized as Landmark varieties of sorghum by ISGPB**





# Progress report- 2019-20



## Multi-location AICSIP yield trials

- Advanced Hybrid Trial (AHT: 6+5 entries at 26 locations- 22 reported)
- Advanced Varietal Trial (AVT: 9+5 entries at 22 locations- 19 reported)
- Initial Hybrid Trial (IHT: 12+6 entries at 14 locations- 13 reported)
- Initial Variety Trial (IVT: 20+5 entries at 16 locations- 15 reported)

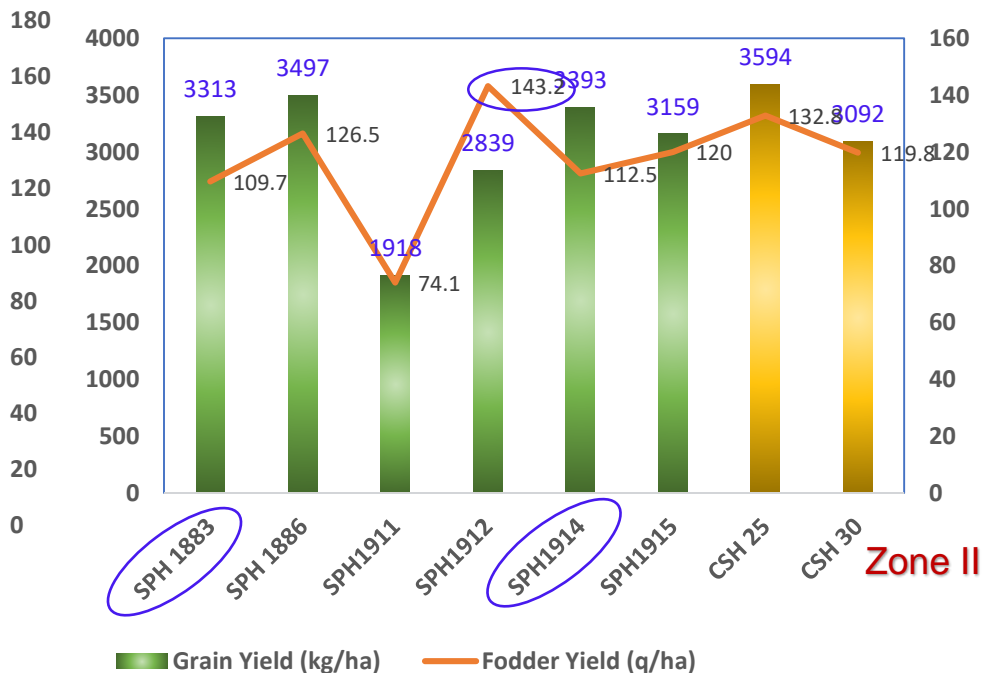
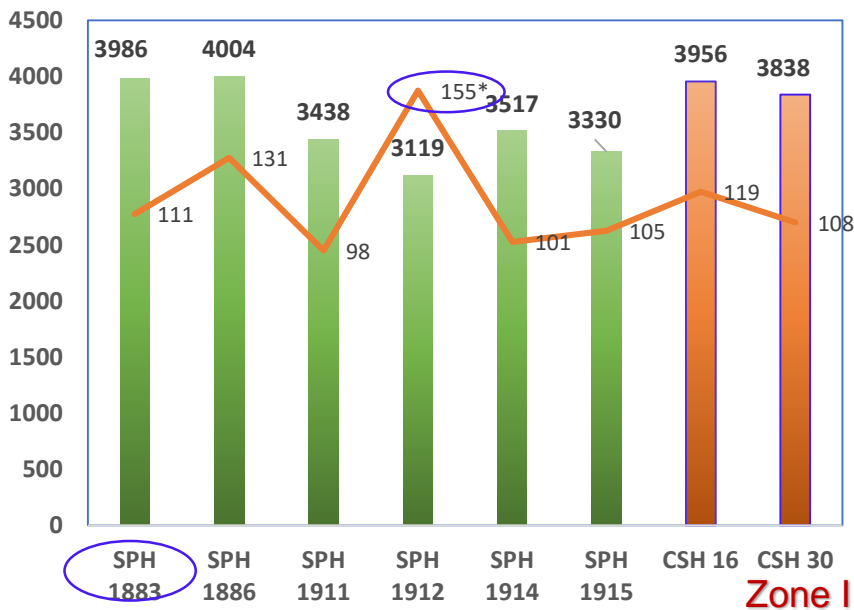
**Efficiency of trial execution: 90.3%**

## Co-ordinated breeding trials

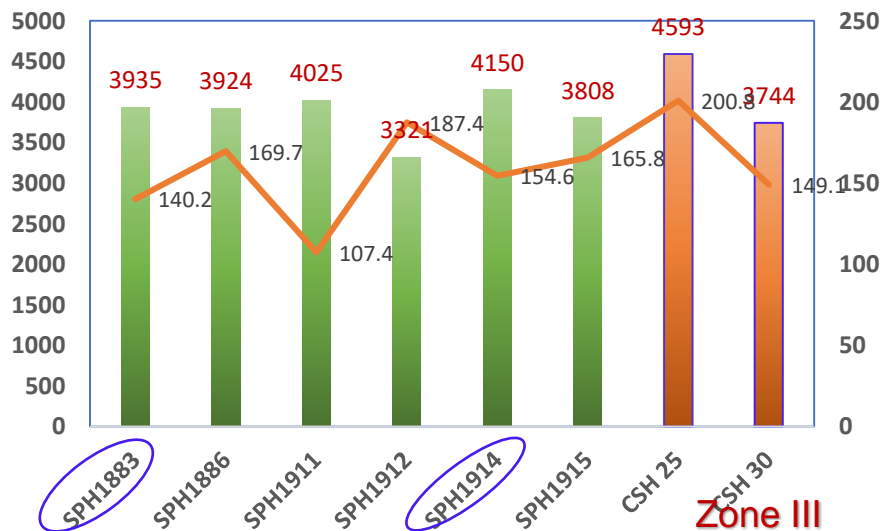
- Initial early hybrid trial (IEHT: 11+2 entries at 6 locations)
- Specialty sorghum trial (ISSVT: 22+3 entries at 5 locations)



# Performance of hybrids in AHT



- SPH 1883 and SPH 1914 were early (100-103 days); 7-13% grain yield advantage over CSH 30
- SPH 1912: Significantly high FY over checks in ZI (cd 5%= 22.4) and 8% improvement in ZII

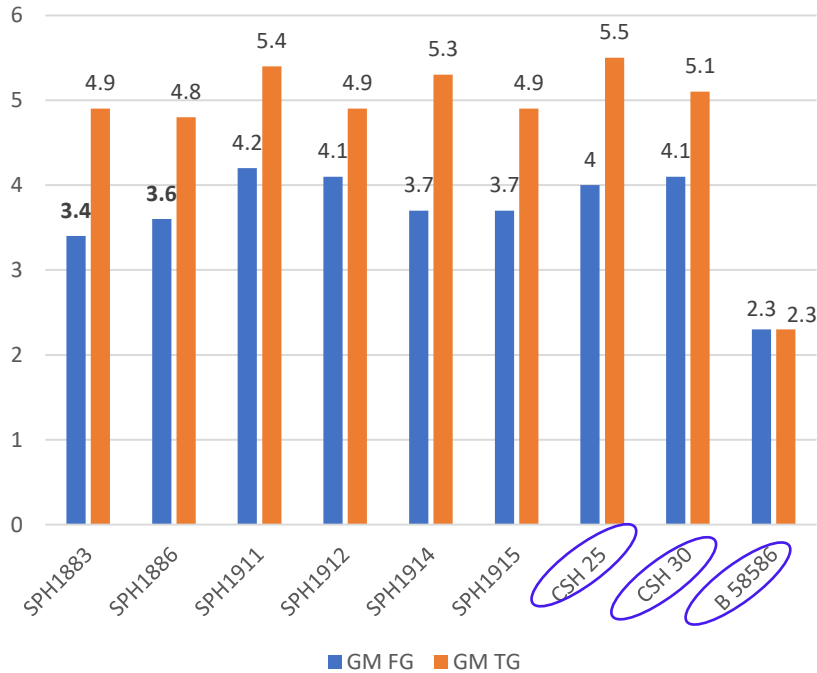


Zone	Cd 5%	CV%
ZI	781	15.1
ZII	799	11.0
ZIII	555	15.6

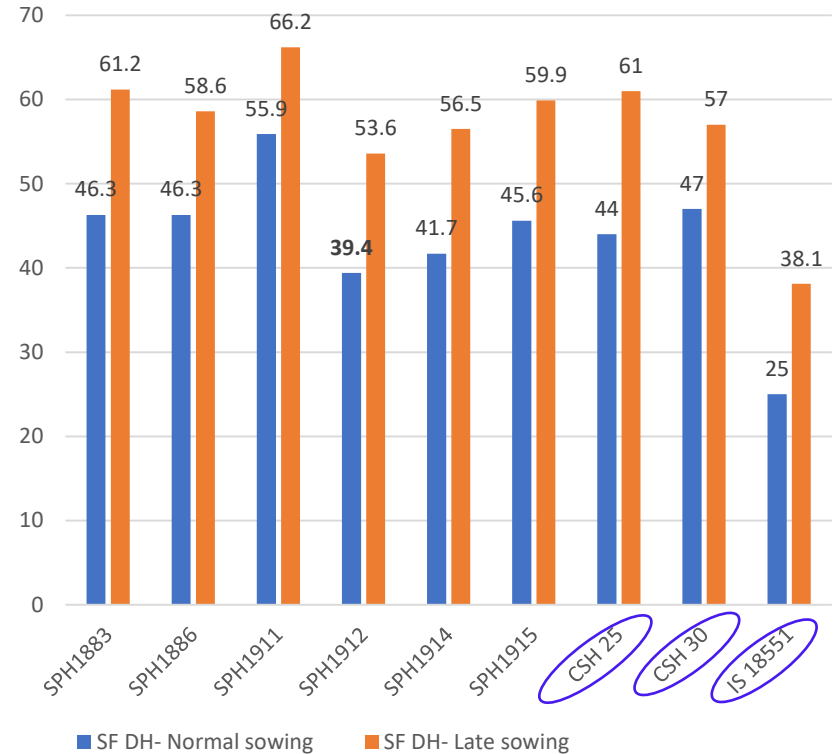
**Entries- 6 (2+4)**  
**Checks- 5**  
**Locations- 8, 7,6**

# Performance of advanced entries for grain molds and shoot fly incidence

### Grain mold score (1-9 Scale)



### Shoot fly DH%



- SPH 1883 and SPH 1886 recorded relatively low GM incidence (3.4 and 3.6 FGS vs 4.1 of CSH 30)
- SPH 1912 recorded low shoot fly deadhearts (39.4% SFDH vs 46.7% in CSH 30)

Trait	Cd 5%
GM-FG	1.2
GM-TG	1.5
SF-Normal	9.6
SF-Late sowing	14.1

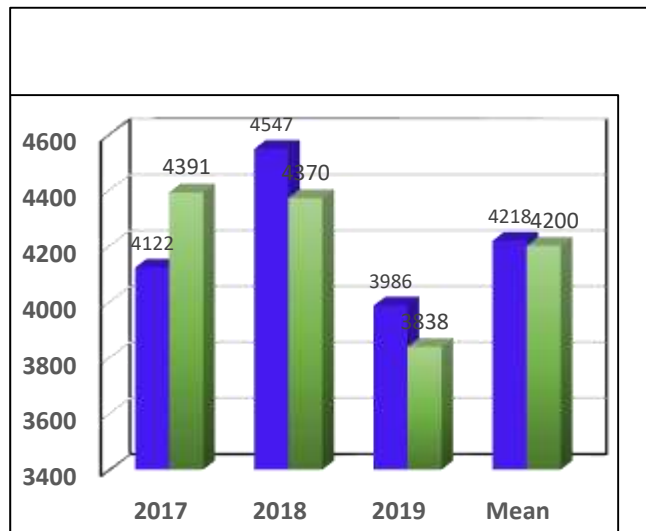


# Hybrids evaluated over 3 years

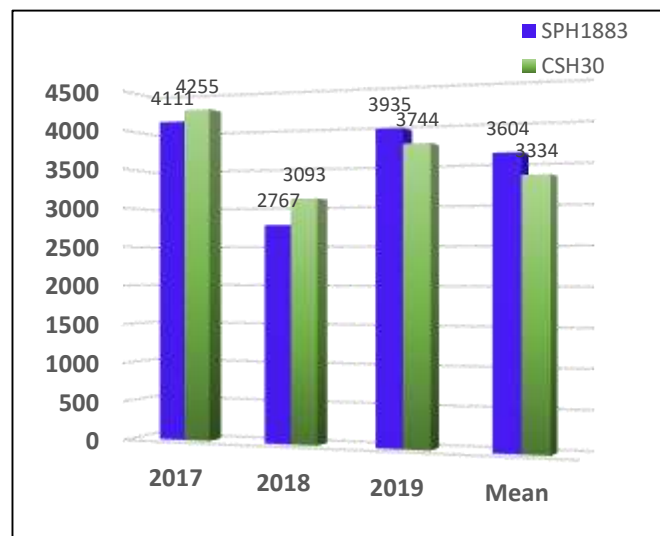


## SPH 1883

### Zone I

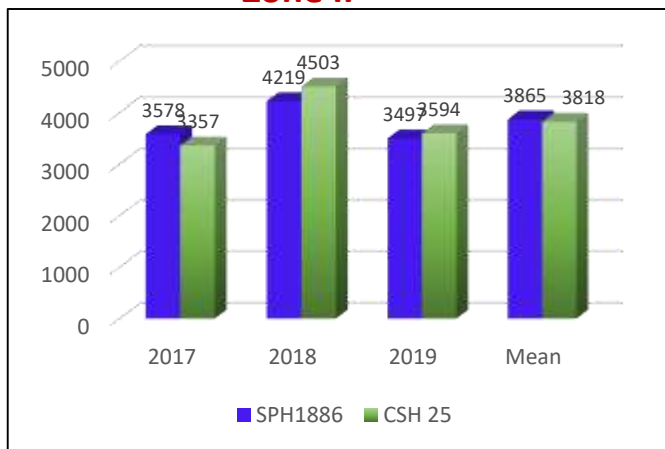


### Zone III

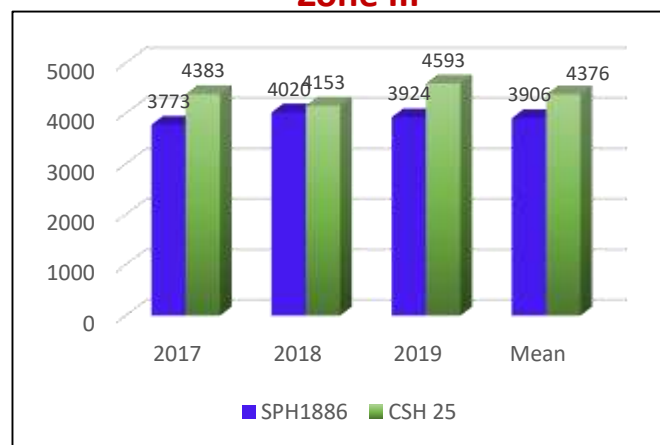


## SPH 1886

### Zone II



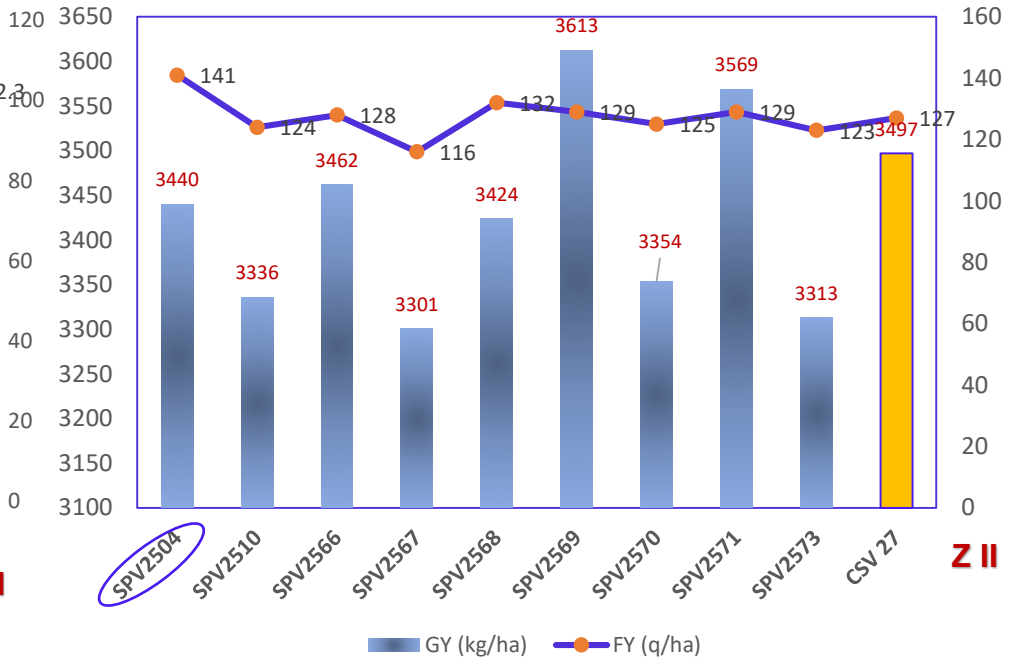
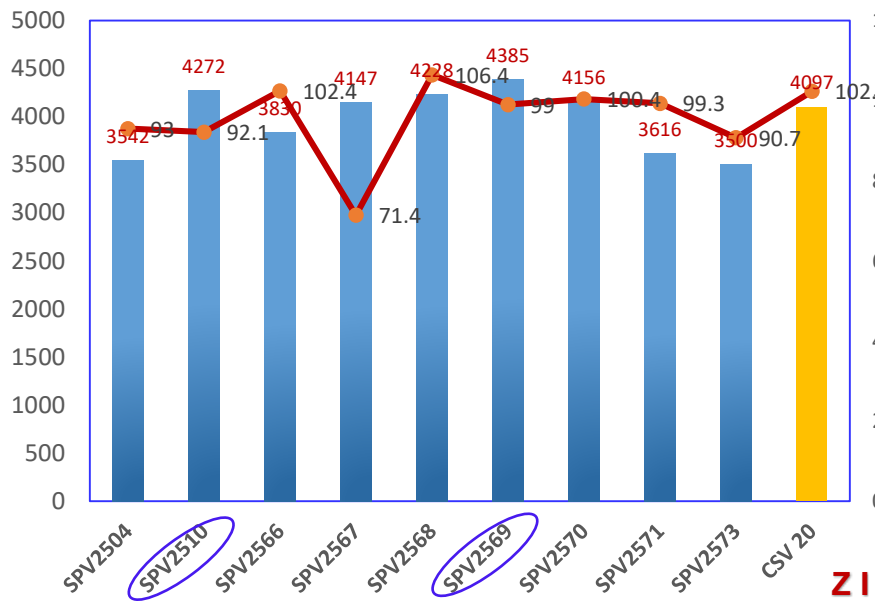
### Zone III



- SPH 1883 had given 8% superiority in grain yield over CSH 30 across zones.
- It has better level of resistance to grain molds (3.9FGS vs 4.2 of CSH 30) and downy mildew (10% vs 19.7% of CSH 30)



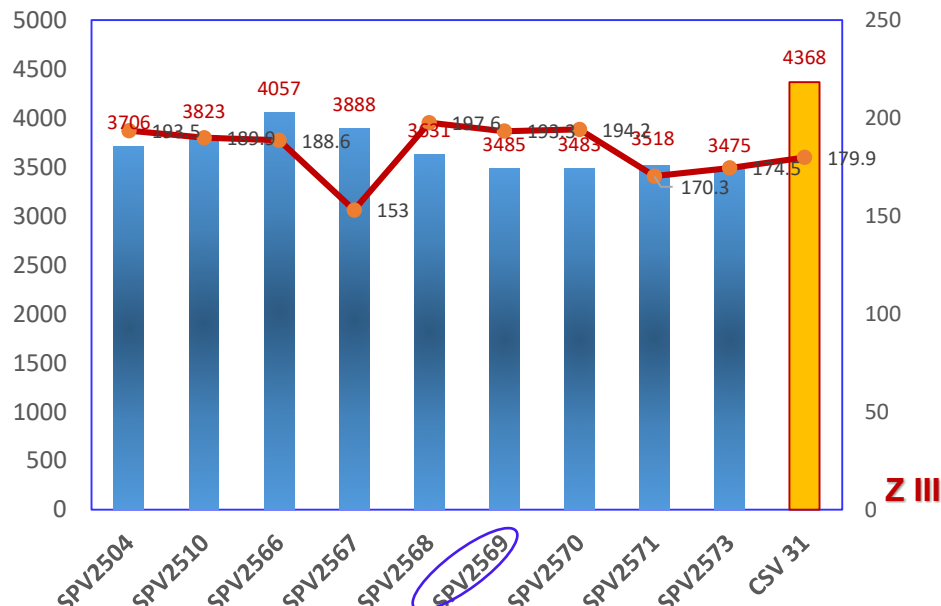
# Performance of varieties in AVT



- SPV 2569 & SPV 2510 recorded >5% grain yield advantage over CSV 20 in ZI
- SPV 2568 & SPV 2569 had bold seed (3.3g/100s)
- For fodder yield, SPV 2504 recorded ~10% yield advantage over CSV 27 in ZII
- SPV 2569-early (103 d) with 12% improvement in GY and >20% in FY over CSV 17 in Z III

Zone	Cd 5%	CV%
ZI	780	15.4
ZII	371	18.5
ZIII	596	14.0

Entries- 9 (2+7)  
Checks- 5  
Locations-6, 7, 6



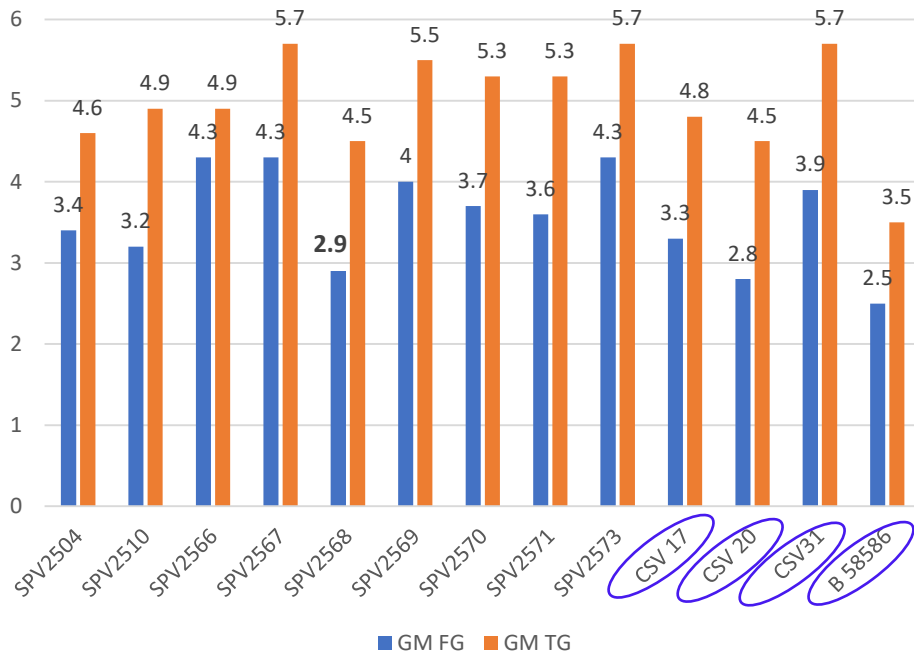




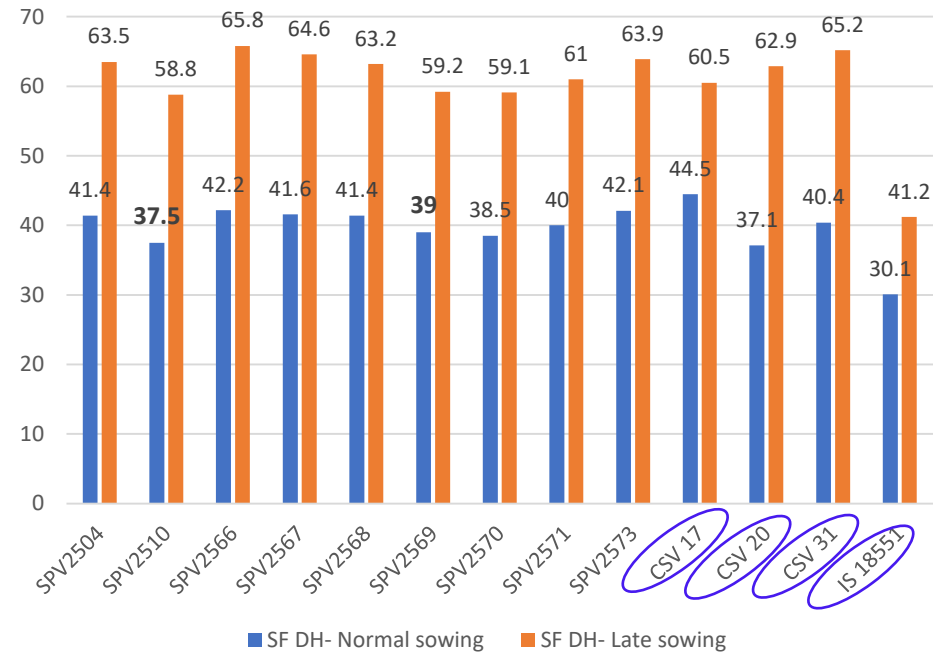
# Performance of advanced varieties for grain molds and shoot fly



Grain mold score (1-9 scale)



Shoot fly deadhearts (%)



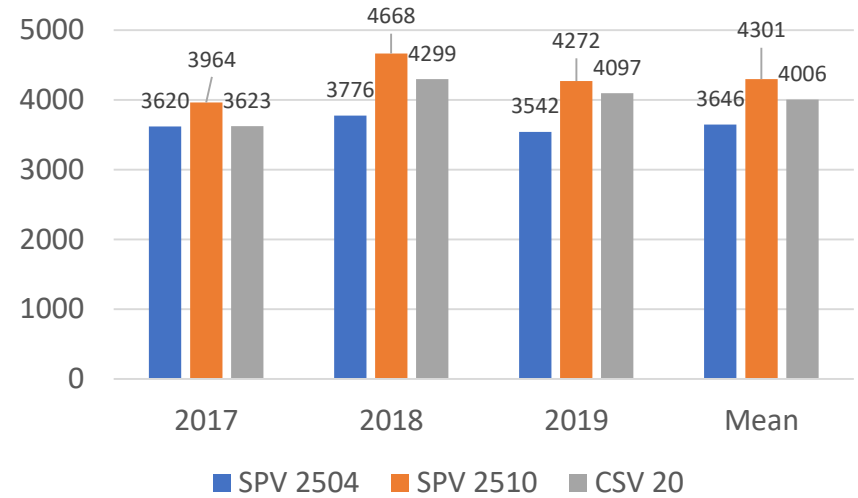
- SPV 2510 and SPV 2569 recorded relatively low SF deadhearts (37.5 and 39% vs 40% in CSV 20)

Trait	Cd 5%
GM-FG	1.26
GM-TG	1.59
SF-Normal	8.7
SF-Late sowing	10.1

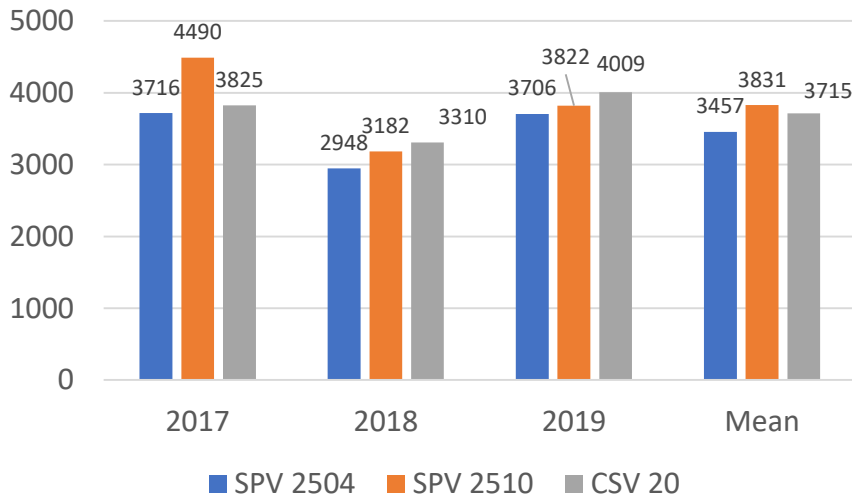
# Performance of varieties evaluated over 3 years

- **SPV 2510- 8% grain yield advantage** in zone I over 3 years
- **SPV 2504- 10% grain yield improvement** in zone II with fodder yield on par with CSV 20

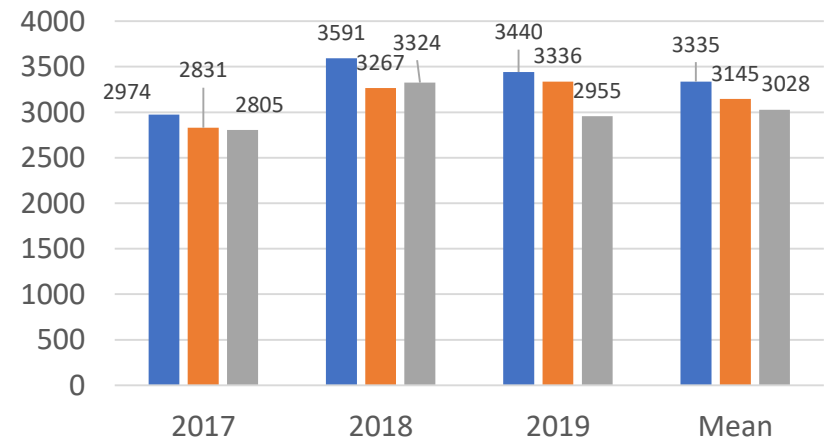
### Zone I



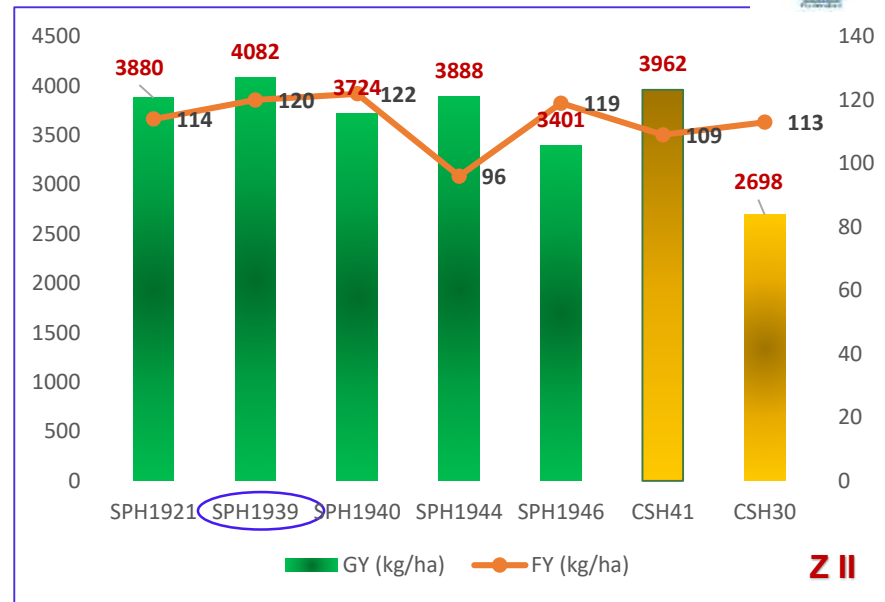
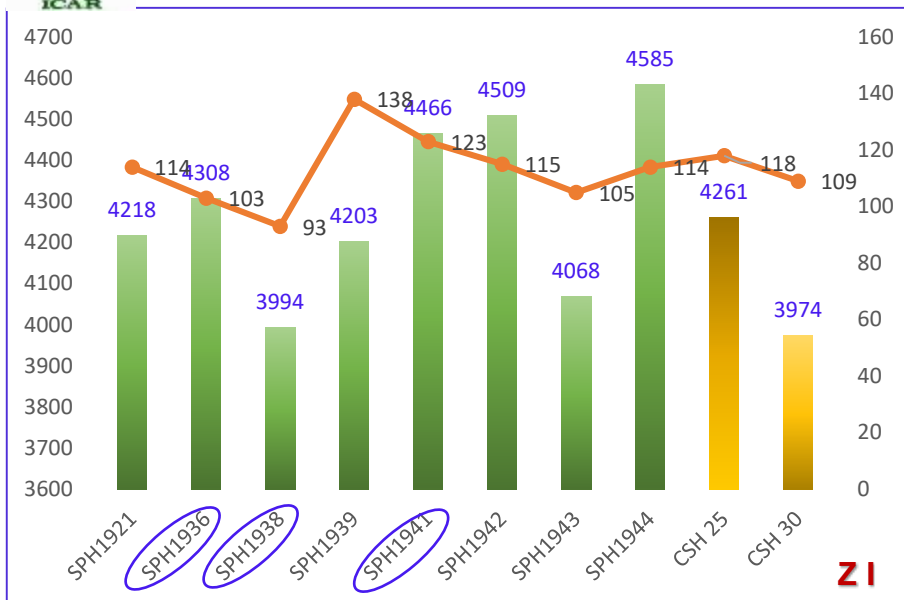
### Zone III



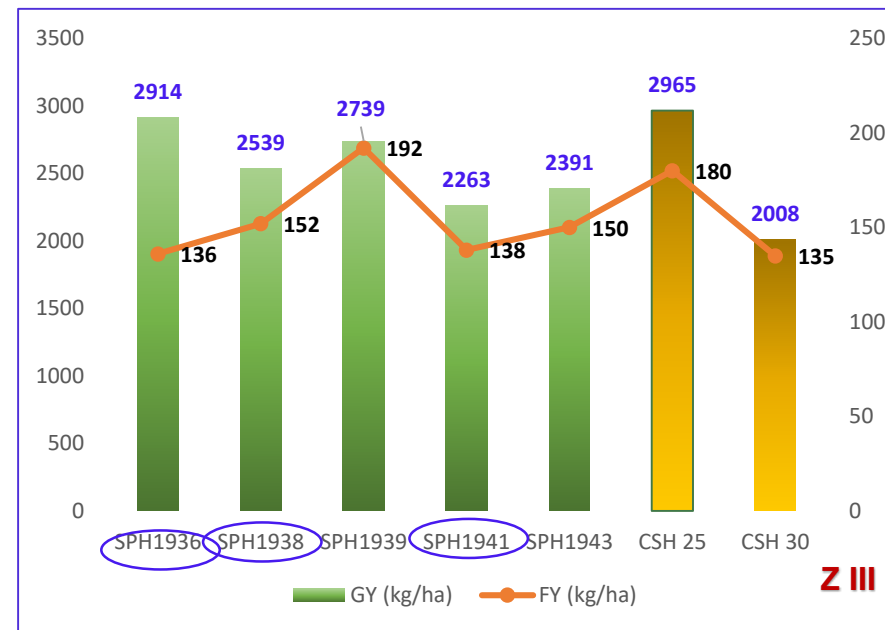
### Zone II



# Performance of hybrids in IHT



- SPH 1936, SPH 1938 and SPH 1941- early with >10% GY over CSH 30 in zones I and III
- SPH 1941 and SPH 1942: bold grain (3.2 g/100 seed)
- SPH 1939-marginal superiority for GY, 10% FY advantage over CSH 41 in ZII
- SPH 1939 had better level of resistance to grain molds (2.8 FGS vs 3.8 of CSH 30), while SPH 1921 and SPH 1942 recorded 3.2 FGS



Entries-12  
Checks- 6  
Locations-6, 5, 3

## Performance of varieties in IVT

### Zone I

Genotype	GY (kg/ha)	% > over check	DFY (q/ha)	% > over check
SPV 2690	4137	8.86	146	0.97
SPV 2674	4103	7.97	145	-
<b>CSV 27</b>	<b>3800</b>	<b>-</b>	<b>145</b>	
Cd 5%	821		27.7	

### Zone II

Genotype	GFY (q/ha)	% > over check	DFY (q/ha)	% > over check
SPV 2688	3550	0.18	132	0.84
SPV 2681	3441	-2.9	128	1.84
<b>CSV20</b>	<b>3544</b>	<b>-</b>	<b>130</b>	<b>-</b>
Cd 5%	345		10.1	

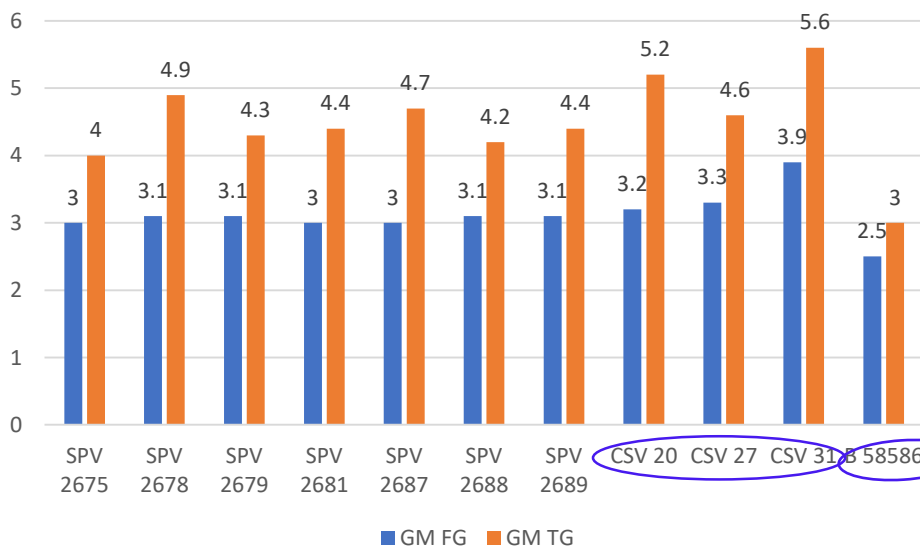
### Zone III

Genotype	GFY (q/ha)	% > over check	DFY (q/ha)	% > over check
SPV 2688	4337	3.07	223	7.39
SPV 2672	4266	1.39	177	-14.8
<b>CSV31</b>	<b>4208</b>	<b>-</b>	<b>208</b>	<b>-</b>
Cd 5%	704		52.5	-

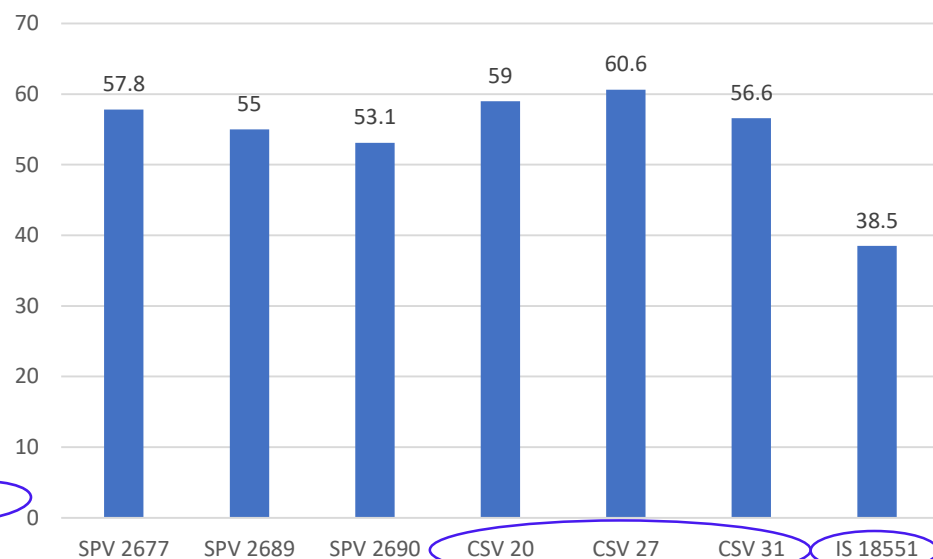
Entries- 20  
Checks- 5  
Locations-6, 5, 4

# Performance of initial varieties for grain molds and shoot fly

Grain mold score (1-9 scale)



Shoot fly deadheart (%)



- Seven varieties recorded GM less than the checks (3.0 – 3.1 FGS)
- 3 varieties (SPV 2677, SPV 2689 and SPV 2690) slightly better than checks for shoot fly incidence

Trait	Cd 5%
GM-FG	1.0
GM-TG	1.1
SF	17.6

## Initial early hybrid trial (IEHT)

Sl. No.	Hybrid	GY	FY	DTF	DTM	PH	GW
1	SPH 1951	4546	106.4	62	103	187	2.92
2	SPH 1950	4485	103	61	104	199	2.79
3	SPH 1955	4455	106	63	105	185	2.92
4	SPH 1949	4113	103	60	100	180	2.99
5	SPH 1952	4247	105	61	102	197	2.95
	CSH 30	4391	114	61	104	209	2.93
	CSH 14	4299	109	61	104	189	2.91
	Mean	4298	106	62	105	195	2.86
	CD(5%)	547.9	10.6	2.53	3.3	15.7	0.23
	CV (%)	14.4	10.9	3.14	3.81	9.22	10.8

GY: grain yield (kg/ha), FY: Fodder yield (q/ha), DTM: days to maturity; PH: plant height (cm), GW: 100 grain weight (g)

- 7 early MS and 7 early R lines contributed by Akola, Dharwad and IIMR were used in hybrid development
- 11 hybrids were evaluated in RCBD at Akola, Dharwad, Parbhani, IIMR, Udaipur and Chamarajnagar

## Initial specialty sorghum trial (ISSVT)

S. No.	Hybrid	Seed color	GY (g/pl)	DTF	DTM	PH	GW	Protein %	Tannin
1	SPV 2617	Yellow	4497	78	126	307	2.57	8.5	3.02
2	SPV 2612	Red	4426	66	114	217	2.51	8.2	4.53
3	SPV 2624	Brown	4190	59	105	230	2.80	8.86	3.65
4	SPV 2626	Yellow	3929	64	110	267	2.44	10.2	2.56
5	SPV 2722	Yellow	3872	65	111	270	2.28	10.3	2.45
	Paiyur 2	Brown	4051	71	117	267	2.67	9.34	3.22
	CSV 20	White	4492	67	112	231	3.01	7.14	1.44
	Mean		3353	67	112	248	2.36	10.3	2.58
	CD(5%)		1417	5.72	7.27	52.4	0.43	1.96	2.93
	CV (%)		15.0	9.1	7.94	10.5	13.2	9.21	54.9



**Genotypes** : 25 (5 red, 11 yellow, 2 brown types from 6 centers)  
**Checks** : 1 red; 1 white checks  
**Locations** : 5 (Palem, Akola, Parbhani, Hagari and Dharwad)

Over two years- SPV 2612, SPV 2624 and SPV 2617 performed well for yield

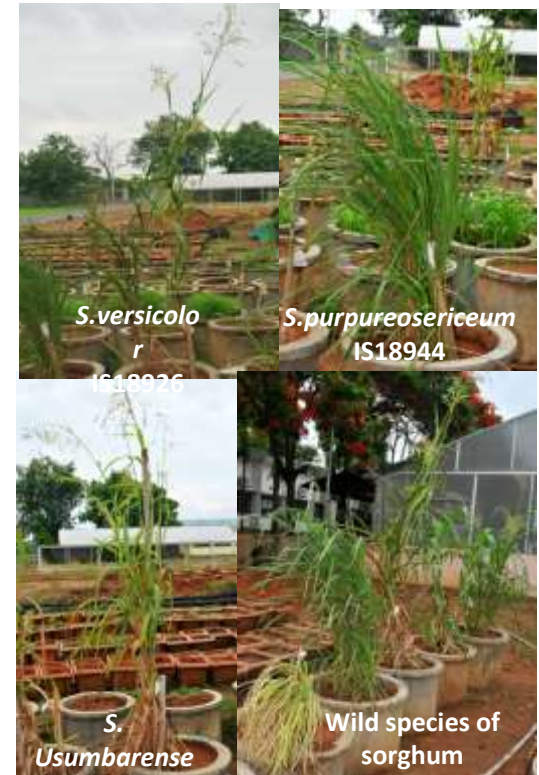
## Efforts to diversify the genetic base

Material utilized	Target traits for improvement
Kharif locals	Grain quality including grain mold resistance
Germplasm from world collection (mainly <i>caudatum</i> and <i>kafir</i> races)	Yield improvement and seed size
Rabi genotypes	To improve grain quality and shoot fly tolerance
Minicore germplasm	Bold grain, grain quality, Shoot Fly tolerance



# New germplasm being used.....

- **Photosensitive guinea germplasm** lines from different countries (Sudan, Zambia, Malawi, Nigeria, Tanzania, Mali, Uganda, Kenya)
  - Highly photosensitive
  - Hard grain with complete glume coverage
- **Colored sorghum** lines
- **Wide hybridization** in sorghum with tertiary wild species is accomplished with the wild species, *S. hewisonii*, *S. versicolor*, *S. purpureoserecium*, *S. australiense* and *S usumberance*.
- Pre-breeding lines are available in crosses involving *S. versicolor* and *S. usumbarensis*.
- Initial screening for shoot fly showed encouraging results in *S. purpureoserecium*.



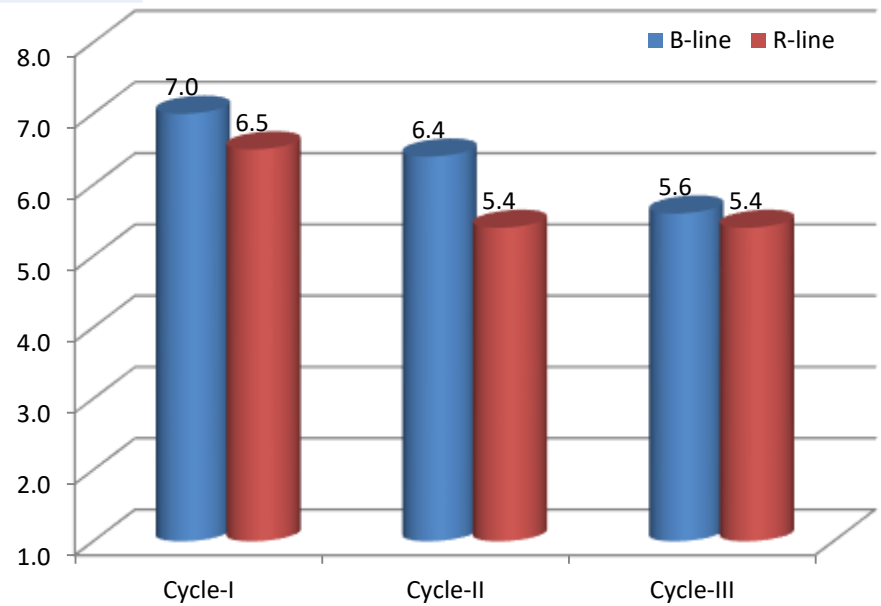


# Improving grain mold resistance through population breeding approach



Population	Cycle	Progenies tested	Selected
B-line Population	Cycle-I	300	34
	Cycle-II	285	25
	Cycle-III	270	22
R-line Population	Cycle-I	300	32
	Cycle-II	211	29
	Cycle-III	252	23

- 220 derivatives from B population
- 105 derivatives from R population



- 165 Population breeding derivatives along with 4 checks were evaluated in augmented design during K18
- 33 derivatives which recorded <5GMS were evaluated during K19
- Centres- Akola, Dharwad, Hyderabad and Parbhani
- Five entries recorded grain weight >2.5g/ 100 seed

Entry	FGS	TGS	DF	100 seed wt	Plant ht (cm)	Panicle shape	Glume cover	Glume color
GM 017	<b>3.13</b>	<b>2.78</b>	72	2.30	198	SL	1/2	Red
GM 030	3.33	3.41	70	2.58	166	SC	1/2	Straw
GM 084	3.47	3.82	77	2.36	174	SL	1/2	L brown
GM 093	<b>2.85</b>	<b>3.61</b>	77	1.89	180	SC	1/4	L red
GM 123	3.68	3.31	75	2.39	158	SL	>1/2	L brown
GM 146	<b>3.29</b>	<b>2.93</b>	76	2.02	156	SC	3/4	Dark brown
296 B	5.64	5.61	75	2.29	169	SC	1/4	Straw
B 58586	2.97	2.67	79	1.78	202	Lax	Full	Straw
Cd (5%)	1.89	2.81	5	0.49	32	-	-	-
CV (%)	26.5	27.8	4.5	15.1	13.6			



## Inter-institutional breeding program- contd..



Centre	No. F <sub>2</sub> pop.	No. of derivatives	Main selection criteria
Chamaraj Nagar	3	54	Compact panicle with good grain filling
Akola	6	25	Higher Grain yield, better grain qualities earliness etc.
Palem	11	85	Earliness and better agronomy
Deesa	6	101	Dual purpose types with compact panicle
Parbhani	6	60	Higher grain yield, more number of primaries, grain mold score
Surat	8	41	Yield and panicle compactness

Type of publication	Number
<b>Journal Papers</b>	<b>21</b>
<b>Posters/Abstracts</b>	<b>13</b>
<b>Popular articles</b>	<b>40</b>
<b>Books/Book chapters</b>	<b>1+6</b>
<b>Field days organized</b>	<b>10</b>



## Technical program for 2020-21



- **Criteria 1:** 10% or more grain yield increase
- **Criteria 2:** >5% increase in GY, FY more, and SF and GM incidence numerically less or on par with the check
- **Criteria 3:** For **early hybrids**, (Extra early:<60 DF and <100DM; Early: <65DF and <105DM), >5% increase in GY, FY on par/more, and SF and GM incidence on par
- **Criteria 4:** GY on par, significant superiority for major pest and disease (SF/SB/GM) resistance or quality
- **Criteria 5:** Hybrid based on diverse cytoplasm with on par with the check for all the traits of interest

### Entries retained in the advanced trials for second year of advanced testing:

AHT- SPH 1914, SPH 1912

AVT- SPV 2568, SPV 2569

### Entries promoted from initial trials for first year of advanced testing:

IHT- SPH 1936, SPH 1938, SPH 1939, SPH 1941, SPH 1921, SPH 1942, SPH 1943, SPH 1944

IVT- SPV 2683, SPV 2688

**Specialty sorghum trial:** SPV 2612, SPV 2617 and SPV 2624 to be tested in AVT



# Technical program and Future plans contd.....



- Inter-institutional hybrid breeding program- 25MS and 29R lines contributed by 6 centers- Akola, Dharwad, Parbhani, Indore, Nandyal and IIMR
  
- Trial on specialty sorghums- colored sorghum and product type
  
- Sharing of material
  - 18 Prebreeding lines- interspecific hybrid derivatives using the wild relatives of sorghum- *Sorghum versicolor* and *Sorghum usumbaranse*
  - Sharing of F2s developed
  
- Segregating material developed using stable resistance sources from pest/disease nursery will be advanced
  
- Multi-location trials



# Thank you

