



Sorghum Physiology

Progress during 2016-2017

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Bijapur, Hyderabad, Tandur, Gulbarga)

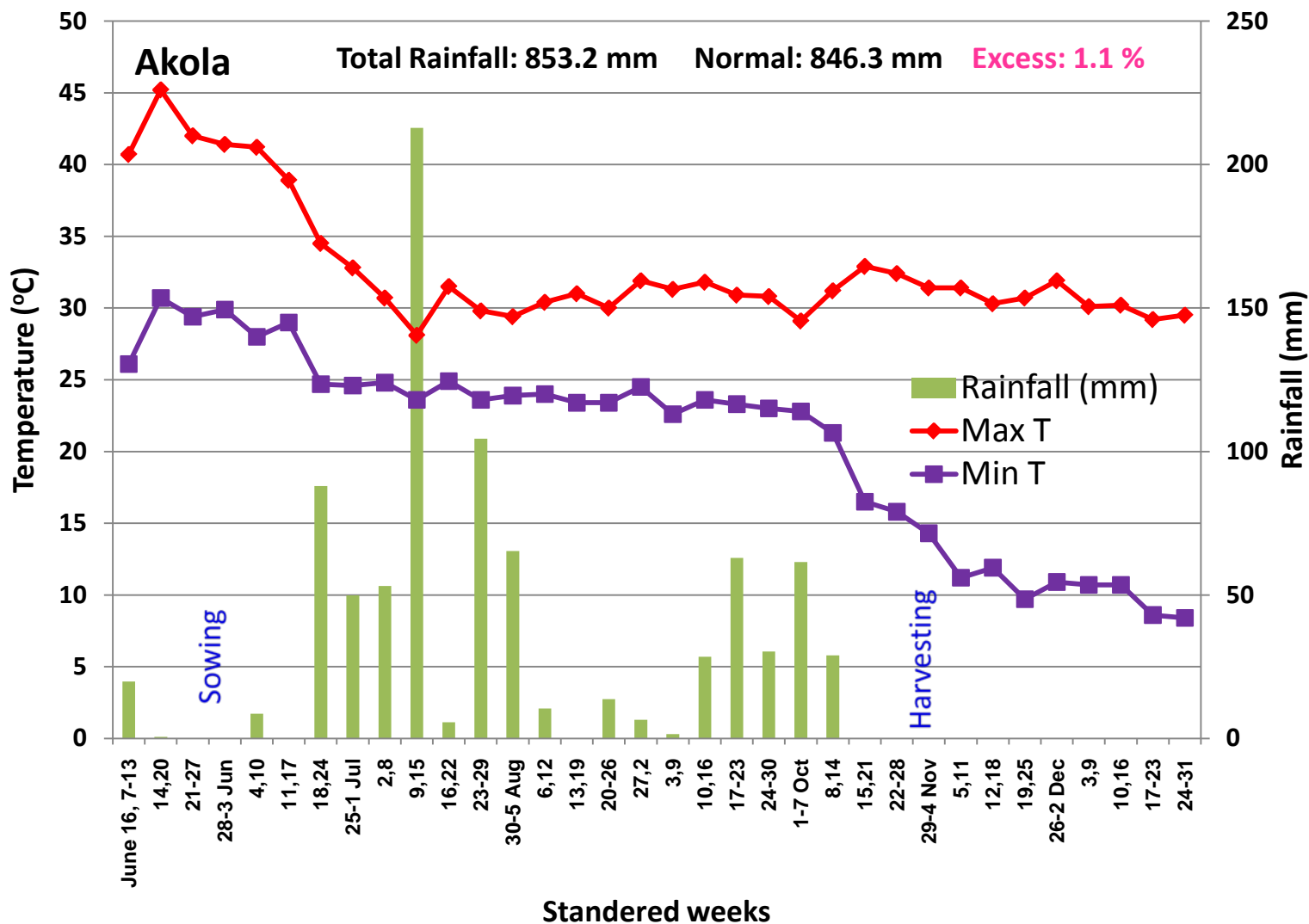
Action Taken Report on Recommendations of AGM 46

Sno	Recommendation	Action Taken
1	Studies on salinity tolerance should be initiated.	Conducted pot experiments on screening of advanced sweet sorghum for salinity tolerance at Hisar & Bapatla. Gangawati (Kar) location for field salinity screening will be included from 2017-18.
2	Critical analysis on the climatic influence during last 40 years of research	Initiated this work in collaboration with crop modeller at ICRISAT. Dr Swarna (Agronomist, IIMR) initiated studies on “Modelling G*E*M interaction in Rabi sorghum” using last 50 years climatic data in APSIM model

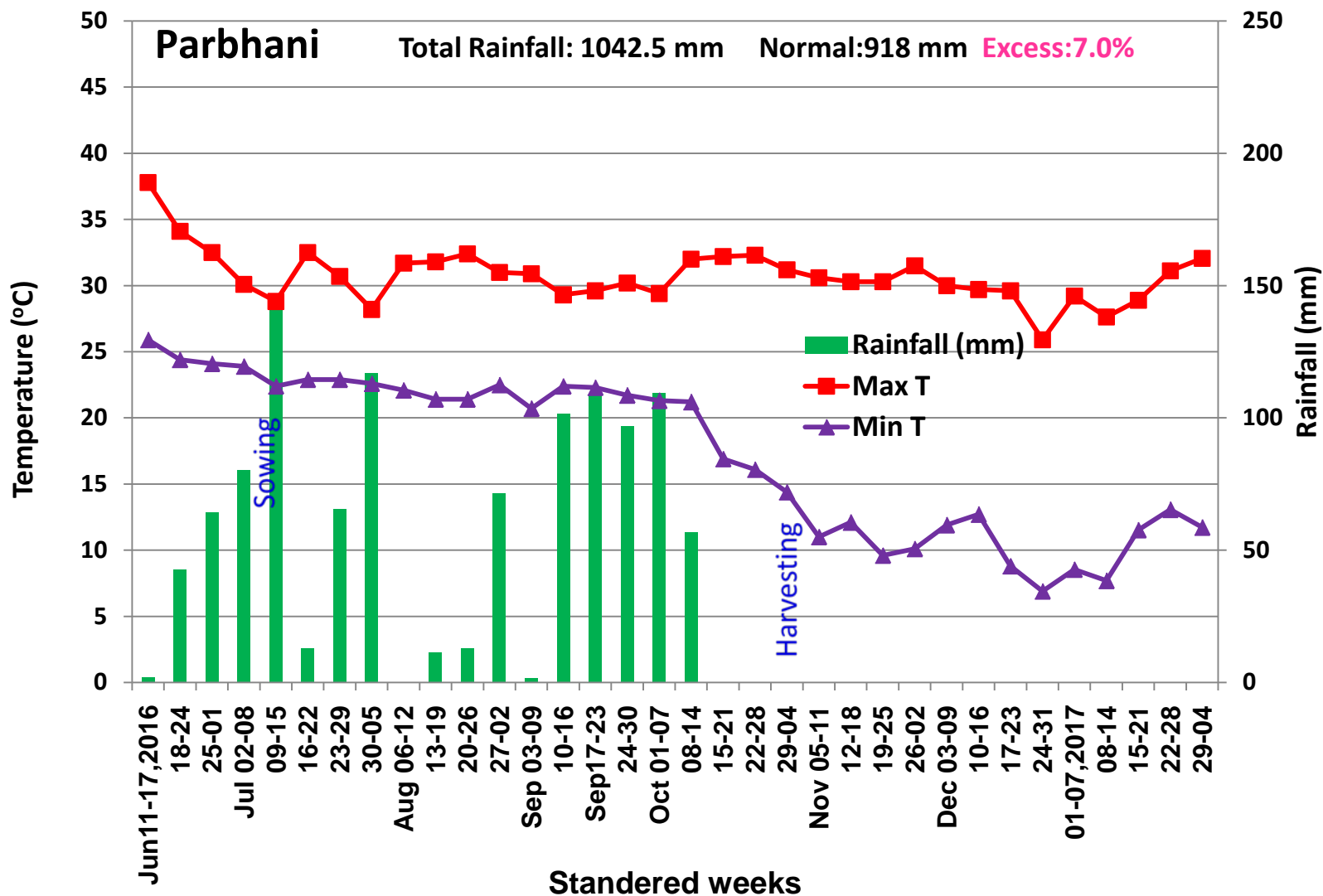
Kharif Trials-2016

Trial ID	Trial	Entries	Locations
1K	Physiological basis of assessing the genetic progress in yield potential of kharif sorghum cultivars historical released during last four decades	12 (6 hybrids + 6 Verities)	3 (Akola Parbhani Phaltan)
2K	Physiological characterization of kharif parental lines for yield potential released during last four decades	16 (8- B + 8- R lines)	3 (Akola Parbhani Phaltan)
3K	Evaluation of elite lines of sweet sorghum for salinity tolerance (Pot expts)	14 + 2 checks	2 (Hisar Bapatla)

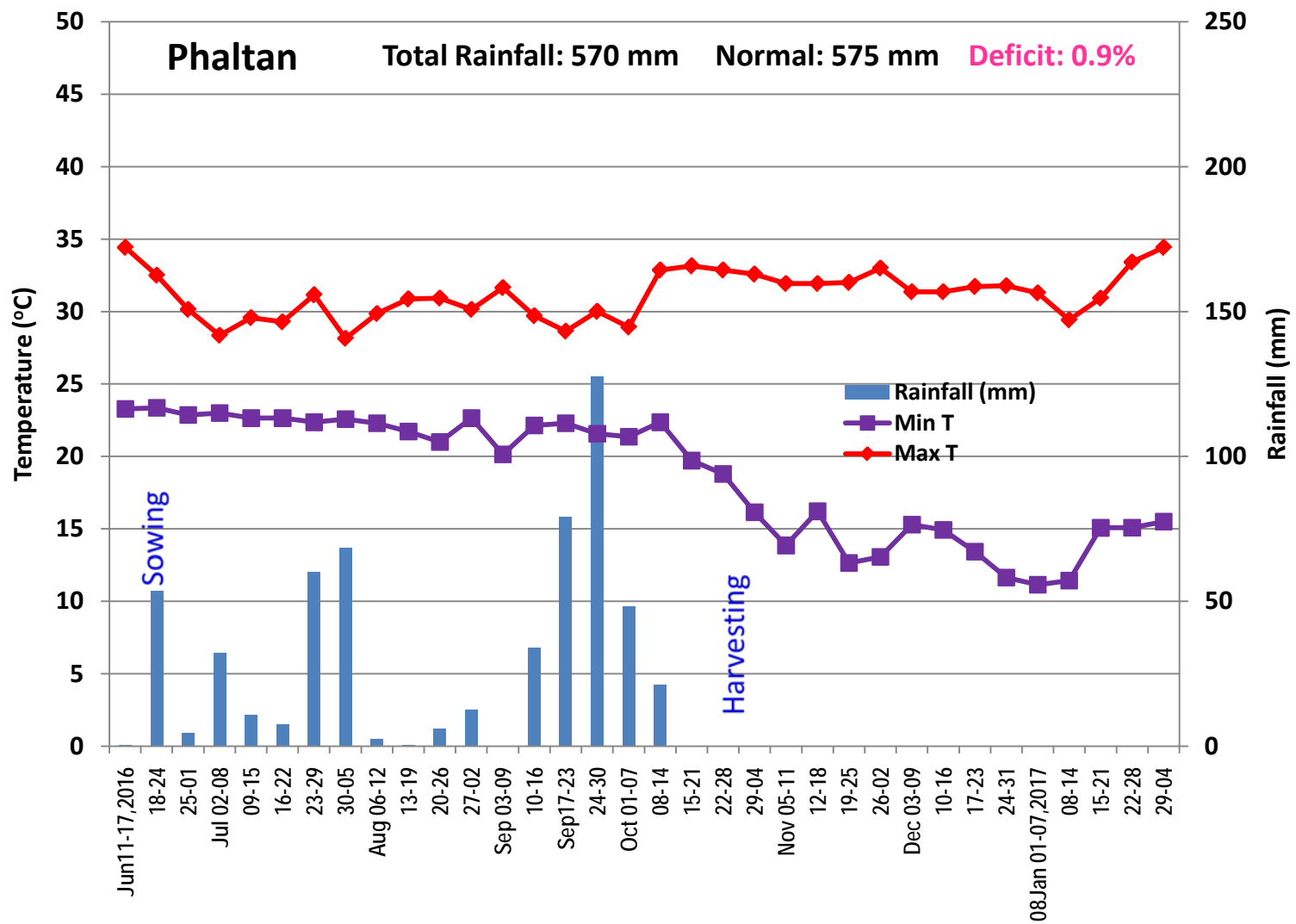
Environmental conditions Akola , Kharif 2016



Environmental conditions Parbhani, Kharif 2016

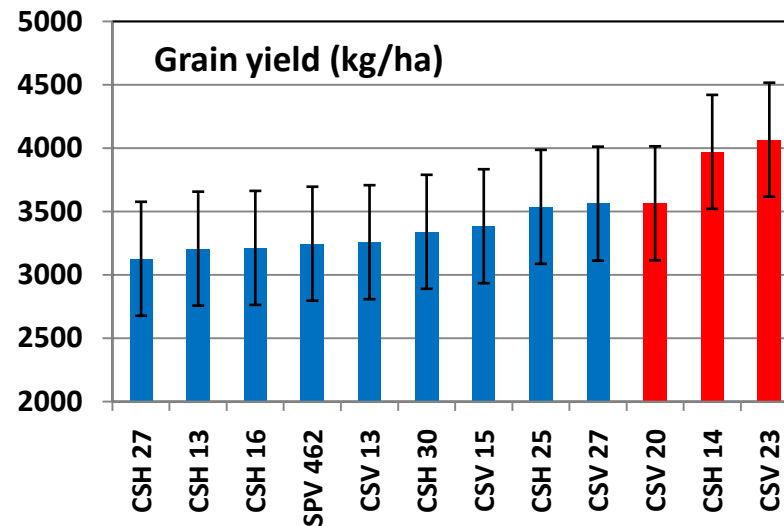


Environmental Conditions Phaltan, Kharif 2016

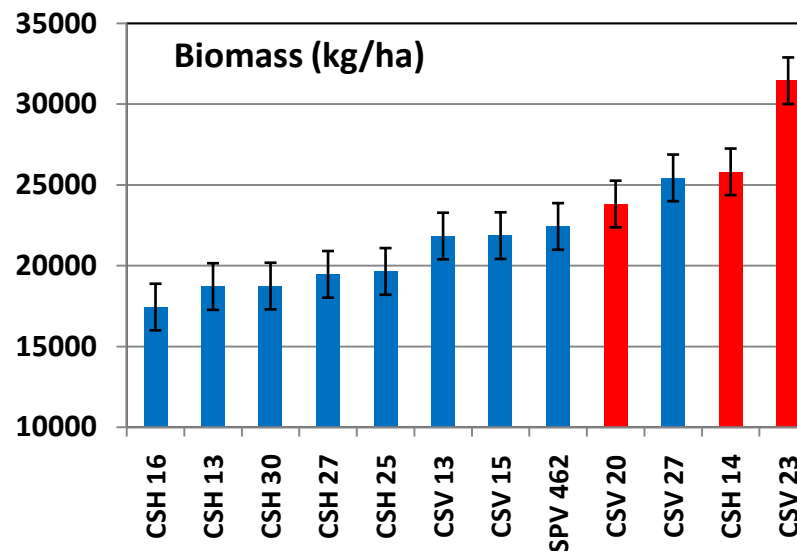


Trail 1k. Physiological basis of assessing the genetic progress in yield potential of kharif sorghum cultivars released during last four decades

1. Twelve kharif sorghum released cultivars (6 hybrids + 6 varieties) were evaluated

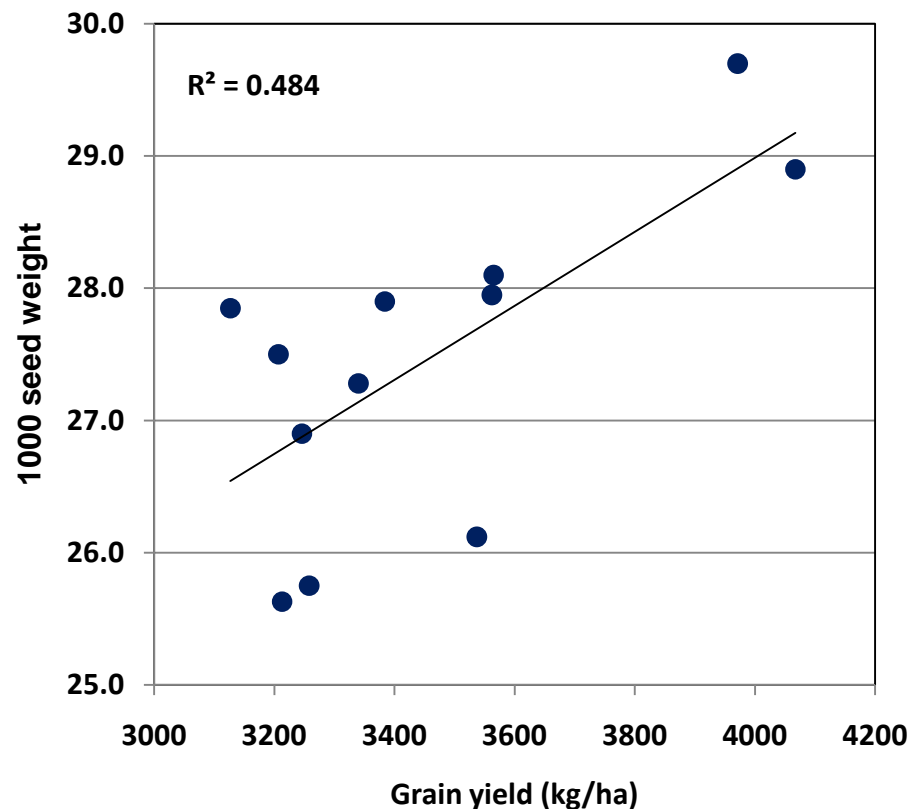


1. **CSV 23, CSH 14 & CSV 20** were the top genotypes in both GY & total biomass accumulation.



Variations in yield components

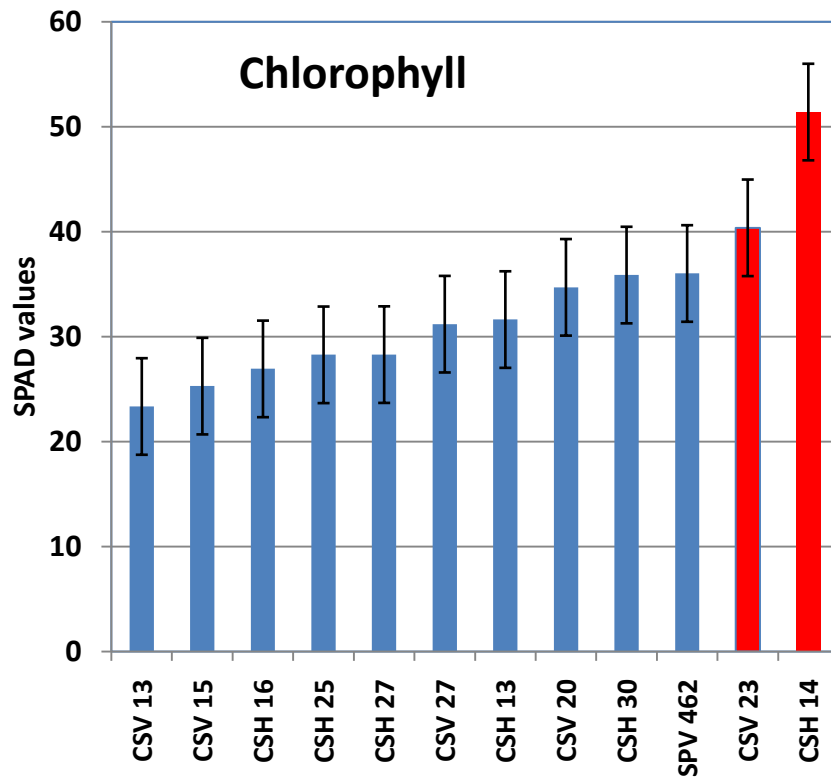
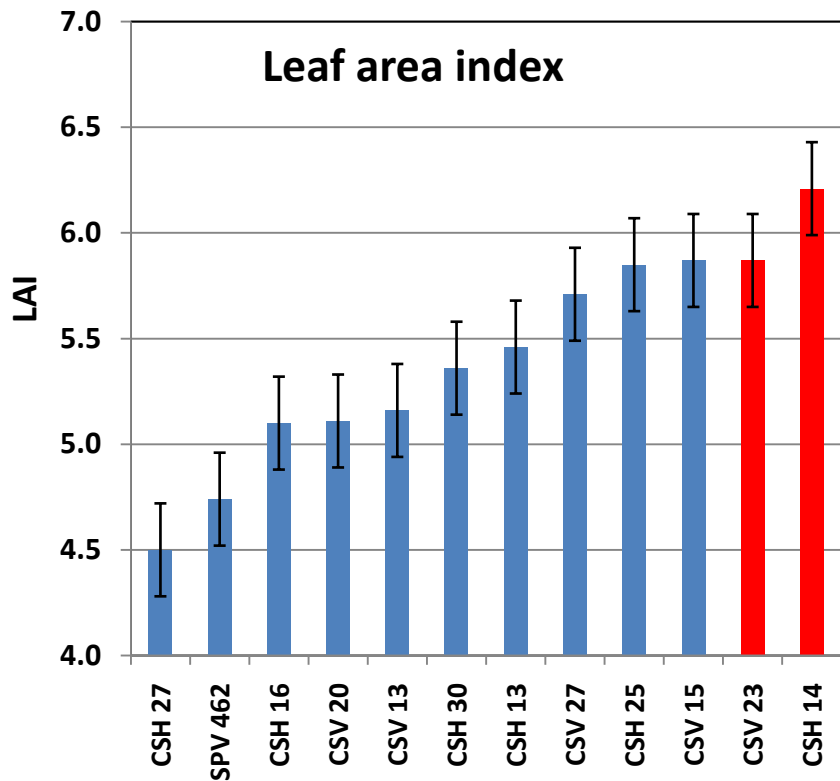
Parameters	Regression coefficient (R ²)
GY >> HI	0.03
GY >> Grain No/panicle	0.12
Gy >> 1000 seed wt	0.48*



Significant variations in HI, Grain numbers & 1000 seed weight under drought
Most of the variations are explained by seed size

1k Cont...

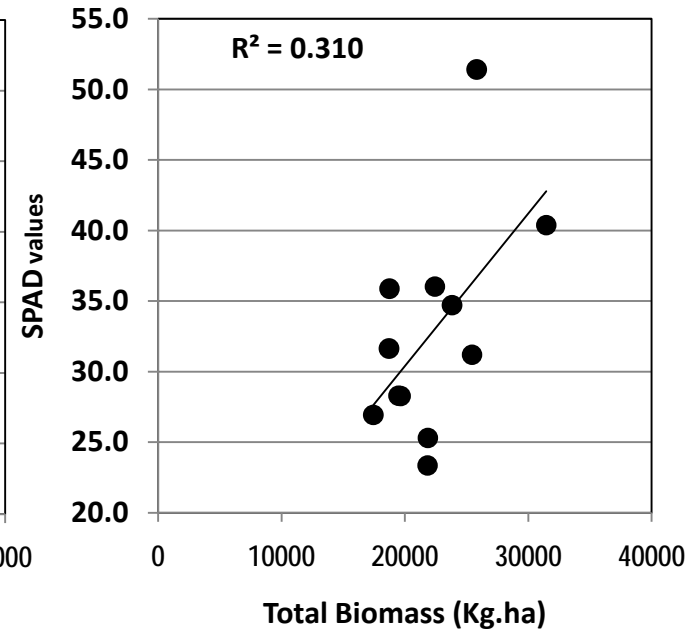
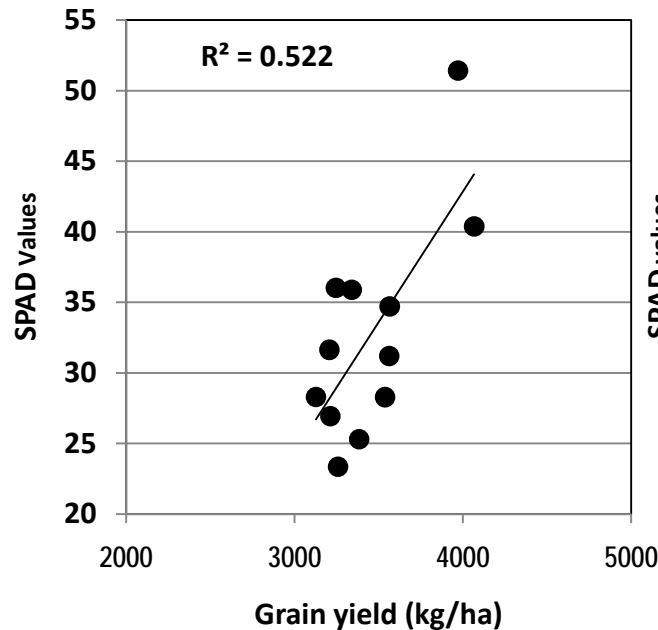
Variations in Physiological traits



CSH 14 & CSV 23 maintains higher LAI, LA, Chlorophyll under stress conditions

Physiological basis of genetic gain in grain & biomass yield

Parameters	Regression cf (R ²)
GY >< SLW	0.26
GY>< RWC	0.01
GY><SPAD	0.52*
GY><LAI	0.31*
BIO><SLW	0.21
BIO><RWC	0.0
BIO><SPAD	0.31*
BIO>< LAI	0.33*

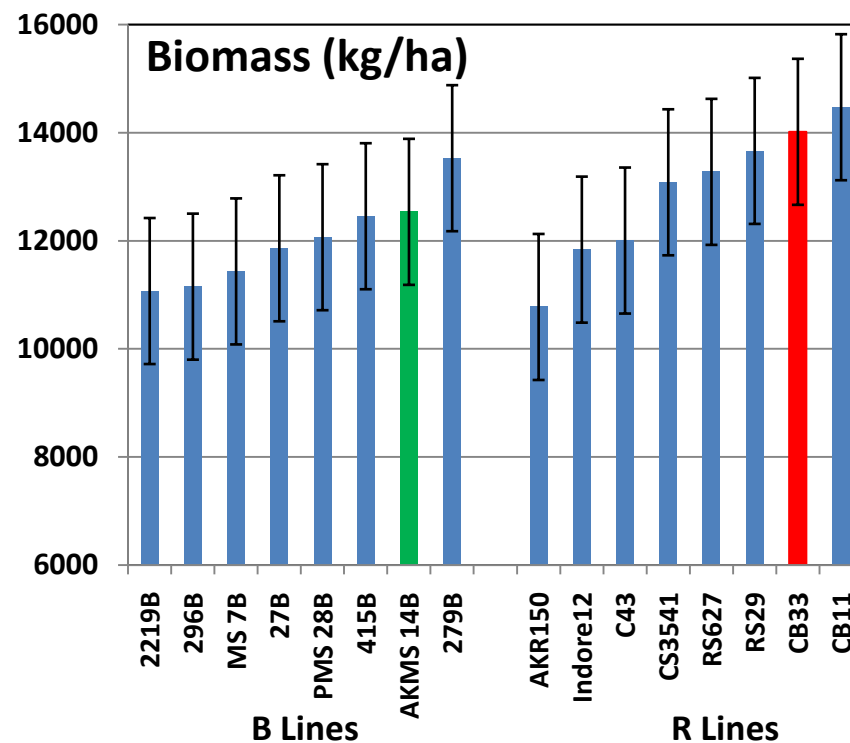
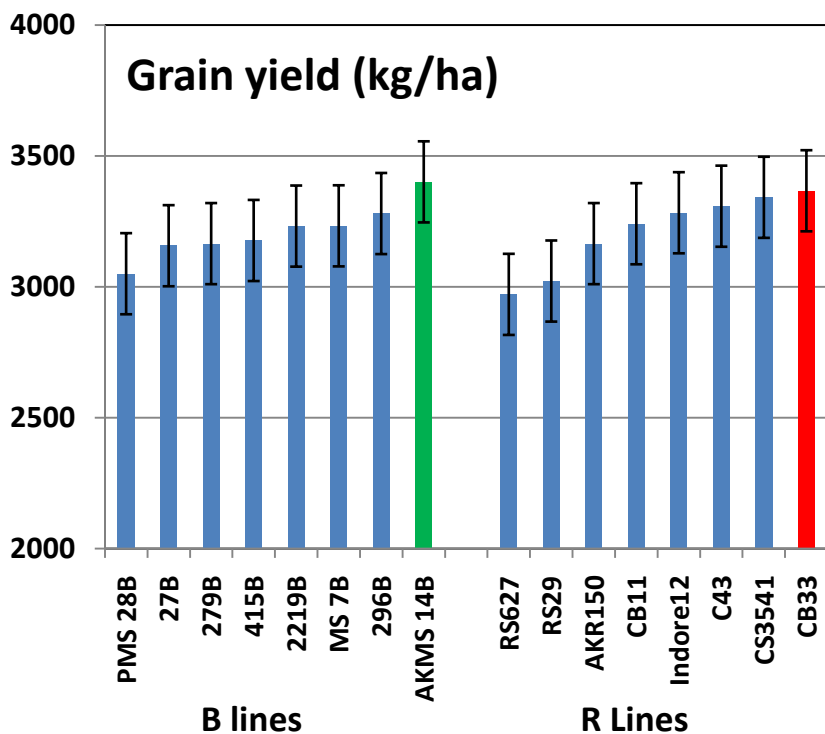


Improvement in Chlorophyll content (SPAD values) explains the genetic gains in GY and Biomass by 31-52 %

Trial 2K: Physiological characterization of parental lines for yield potential released during last 4 decades

- Sixteen parental lines (8-B & 8-R) were evaluated for phenology, yield components & physiological characteristics.
- Among the B lines, **AKMS 14B** was the top grain yielder followed by 296B. while Biomass was maximum in 279B followed by **AKMS 14B**
- Among R lines **CB 33** produced highest GY followed by CS3541. among B lines, while Biomass was maximum in CB11 followed by **CB 33** and RS 29 among R lines .
- Variations in Physiological traits like SPAD, SLA, RWC, CSI, etc were highly significant, but different genotypes have improved adaptation in different physiological traits.

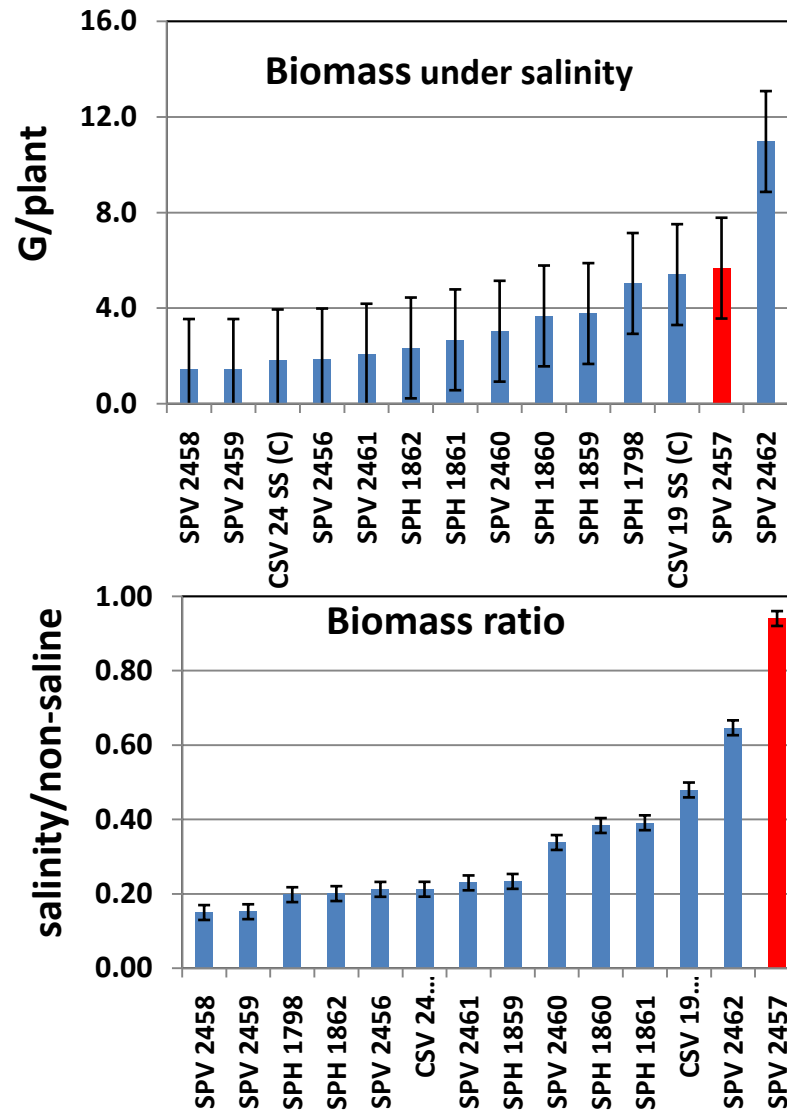
Variations in Grain yield and Biomass yields among parental lines



AKMS 14 B- top B line & CB 33 top R lines for both GY and Biomass accumulation

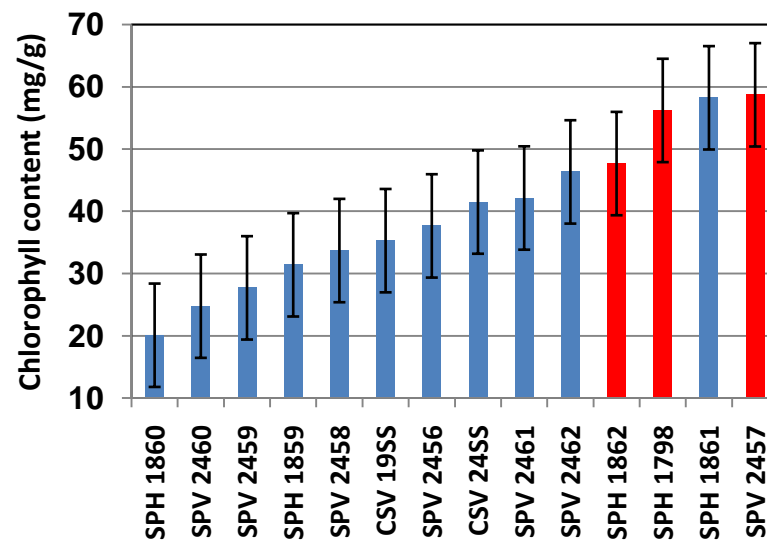
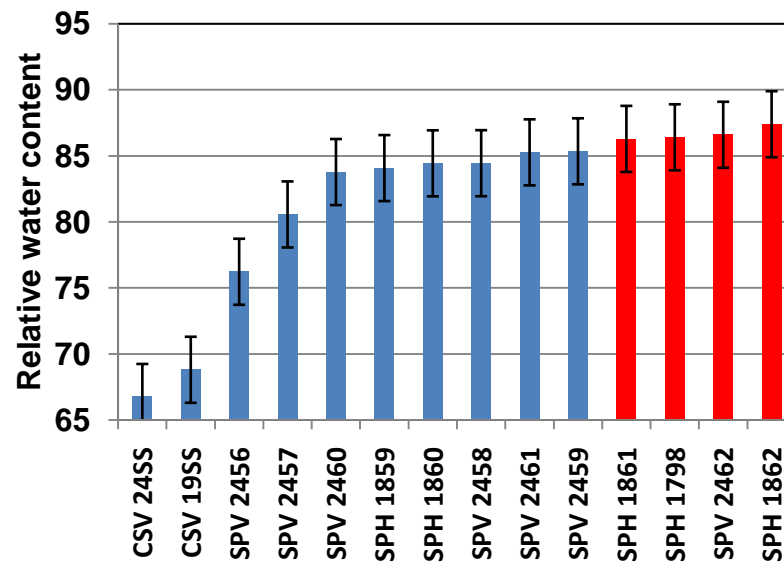
Trial 3K. Evaluation of elite lines of Sweet sorghum for salinity tolerance

- 18 genotypes evaluated under 2 levels of salinity 8 & 10 dS/m
- SPV 1825, 1858 2324 & CSV 22SS died under lower level of salinity at seedling stage.
- SPV 2462, 2457 & CSV 19SS accumulated highest quantity of Biomass under salinity.
- Reduction in biomass under salinity ranged 6-85%
SVP 2457-6%, SPV 2462 -36%
- Only 5 genotypes produced Grain & maximum was in **SPV 2457** followed by **SPV 1861**.

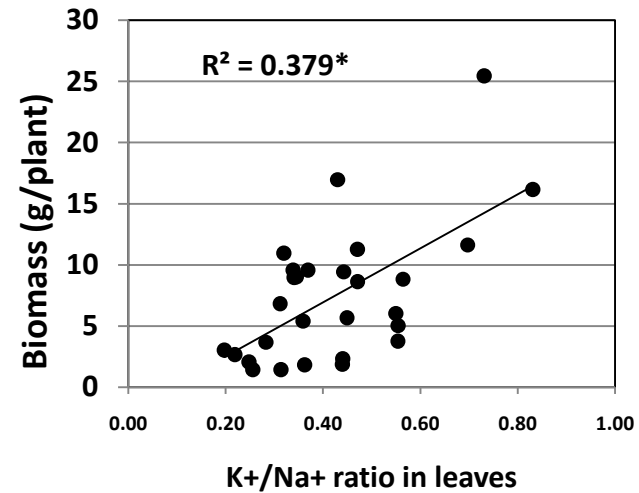
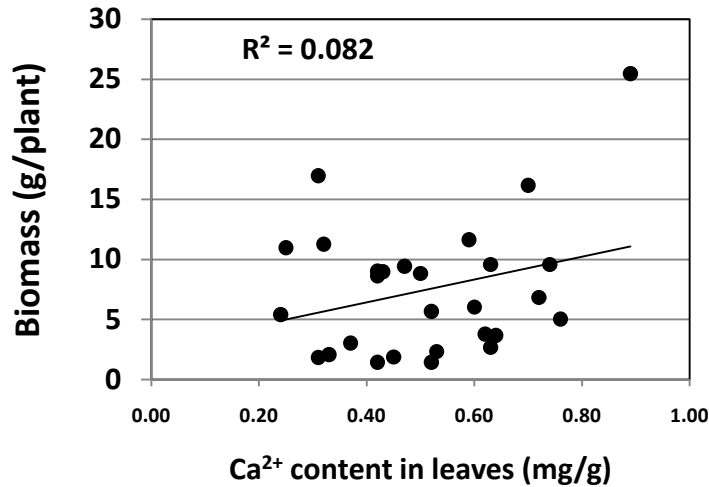
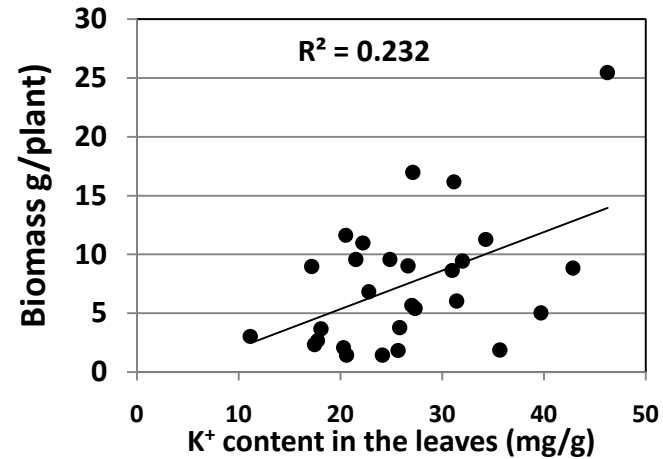
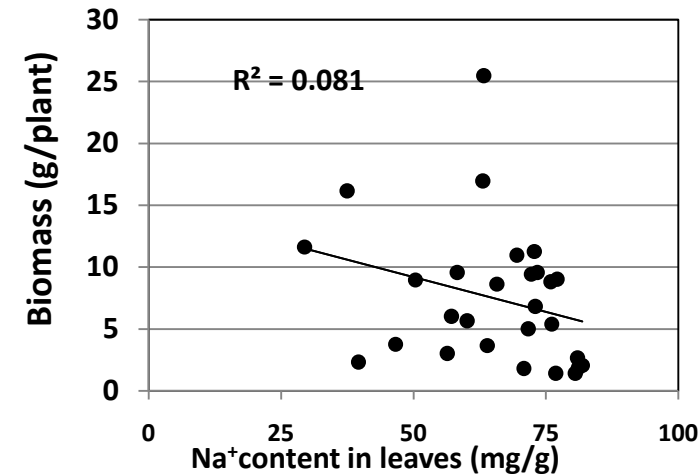


Variations in Physiological traits

- Reduction of >10%, 31% & 15% in RWC, Chl. content & SPAD values under salinity
- SPV 1862, 2462, 2457 & 1798 maintains the highest values under salinity.



Relationships between biomass & ionic contents

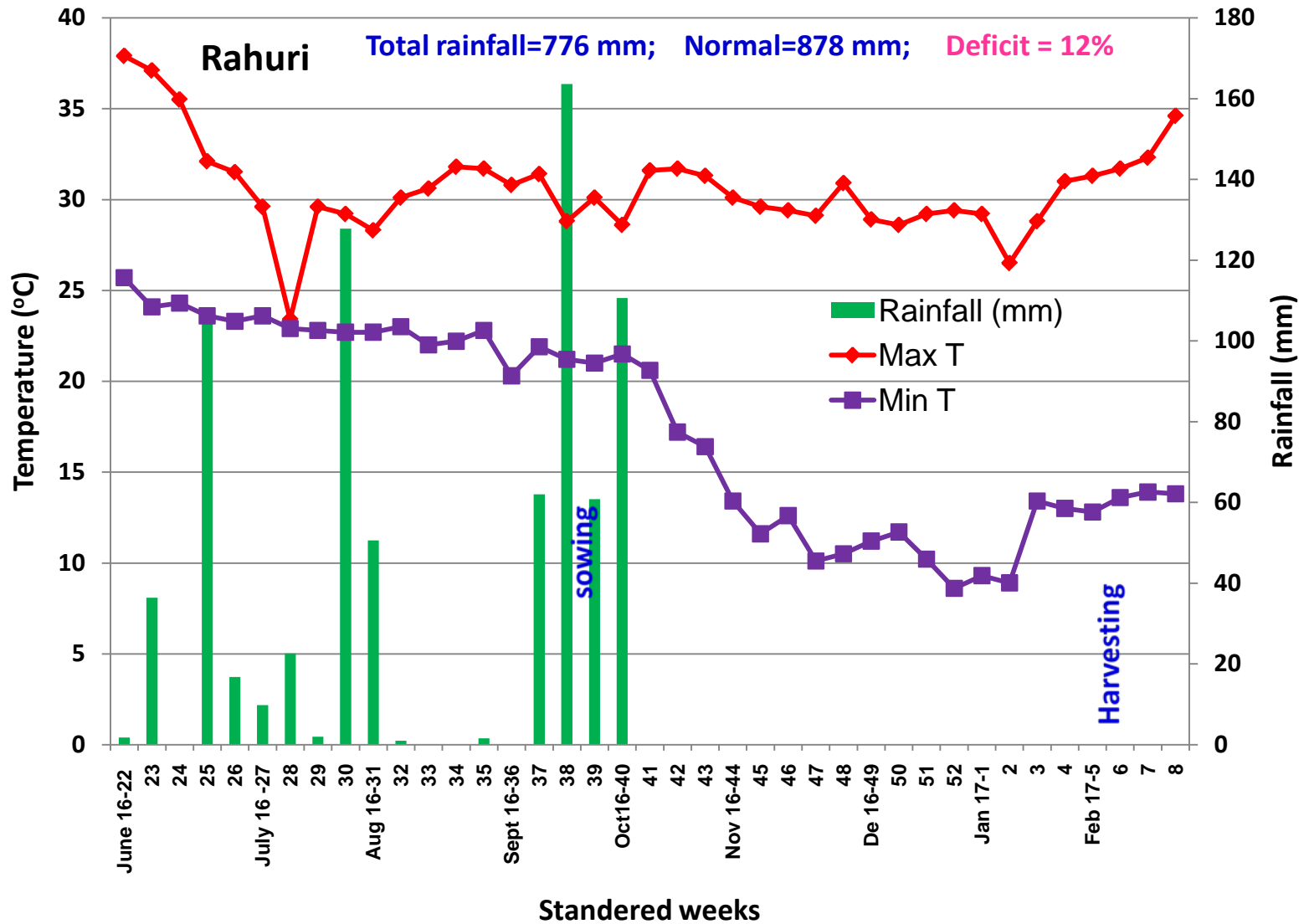


Relationship of K⁺/Na⁺ ratio with biomass accumulation is poor, but significant. Ionic ratio of K⁺/Na⁺ can be potential selection criteria.

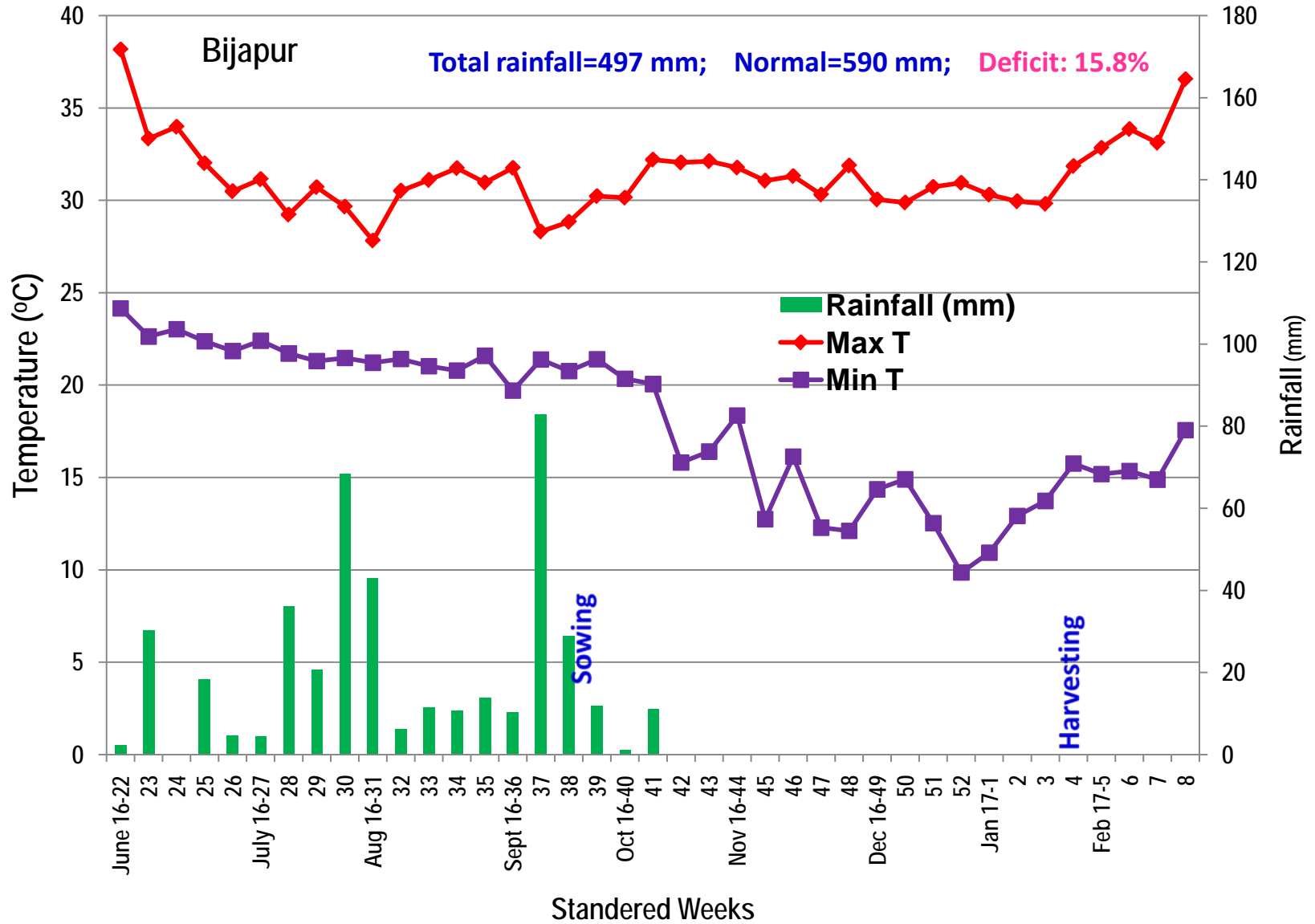
Rabi Trials -2016-17

Trial ID	Trial	Entries	Locations
1R	Preliminary evaluation of diverse germplasm for rabi adaptation	37 + 3 Checks	6 (Rahuri, Bijapur, Solapur, Parbhani Tandur, Gulbarga)
2M & 3S	Phenotyping advanced rabi sorghum entries for drought adaptation traits in medium and shallow soils.	13 + 3 checks	4 (Rahuri, Bijapur, Solapur, Tandur)
4RF & 4Irr	Phenotyping sorghum for key root traits associated with drought adaptation	13 + 3 checks	Rahuri

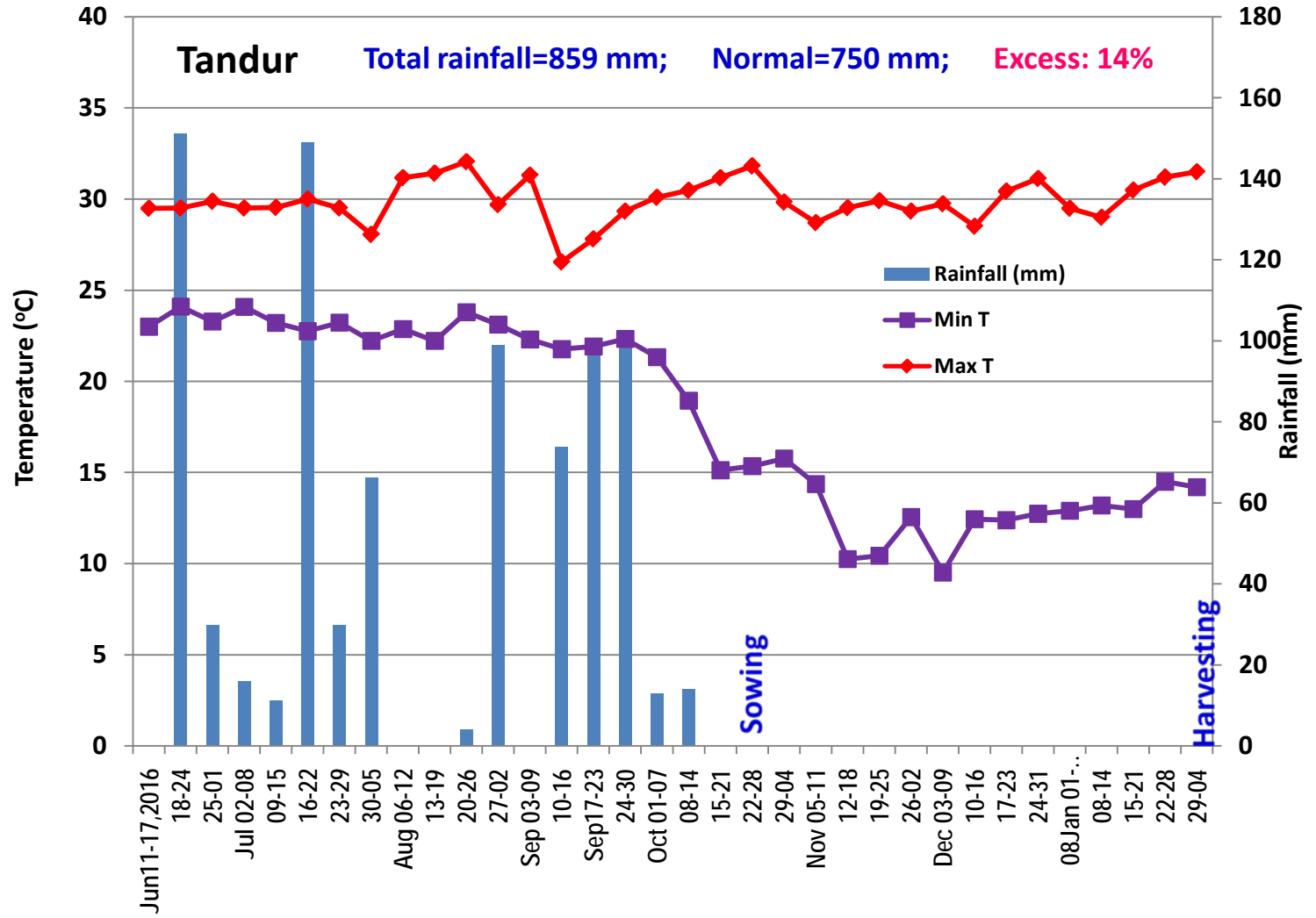
Environmental conditions Rahuri 2016-17



Environmental conditions Bijapur 2016-17



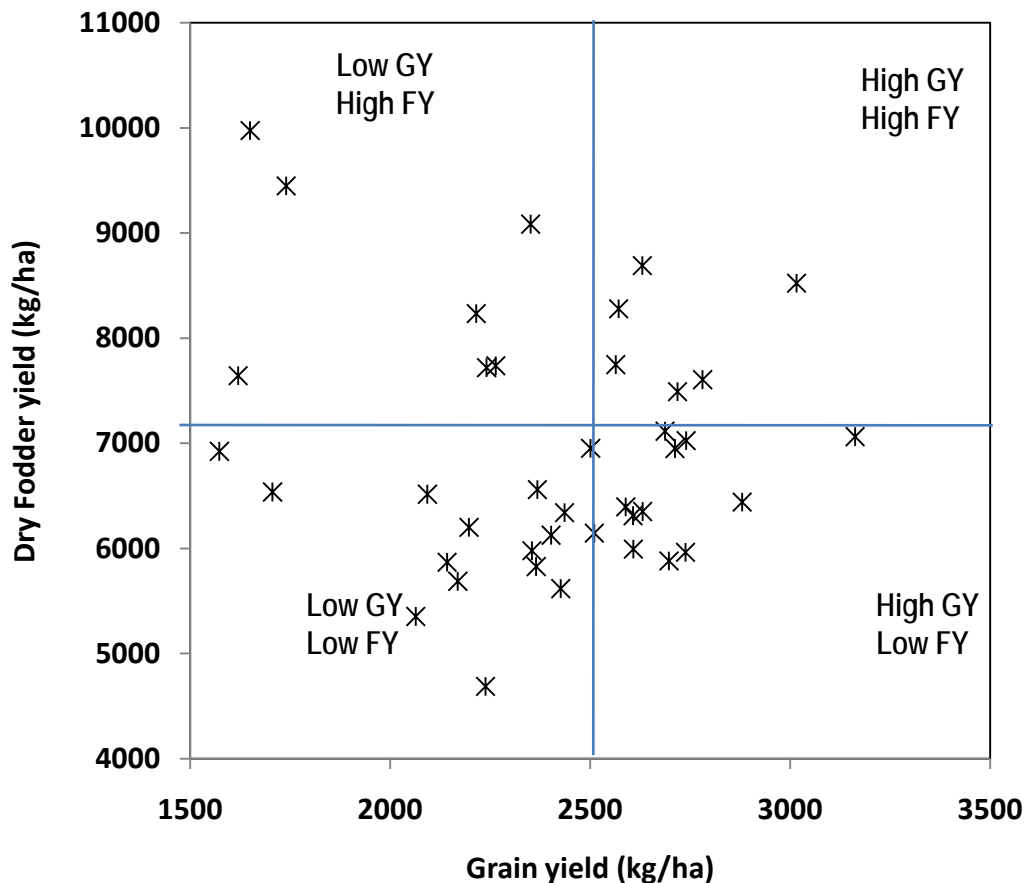
Environmental conditions Tandur 2016-17



Trial 1R: Preliminary evaluation of diverse germplasm for Rabi adaptation

- 37 landrace along with three checks were evaluated at six locations.
- Average Grain yield across locations varied between 1.57 to 3.16t/ha.
- Average dry fodder yield across locations varied between 4.69 to 9.98 t/ha.
- Significant positive relationship between HI with grain yield and negative relationship with fodder yield were recorded
- No relationship between physiological parameter (RWC, SPAD values & LAI) with yield components was observed

Average performance of landraces/germplasm in 6 locations



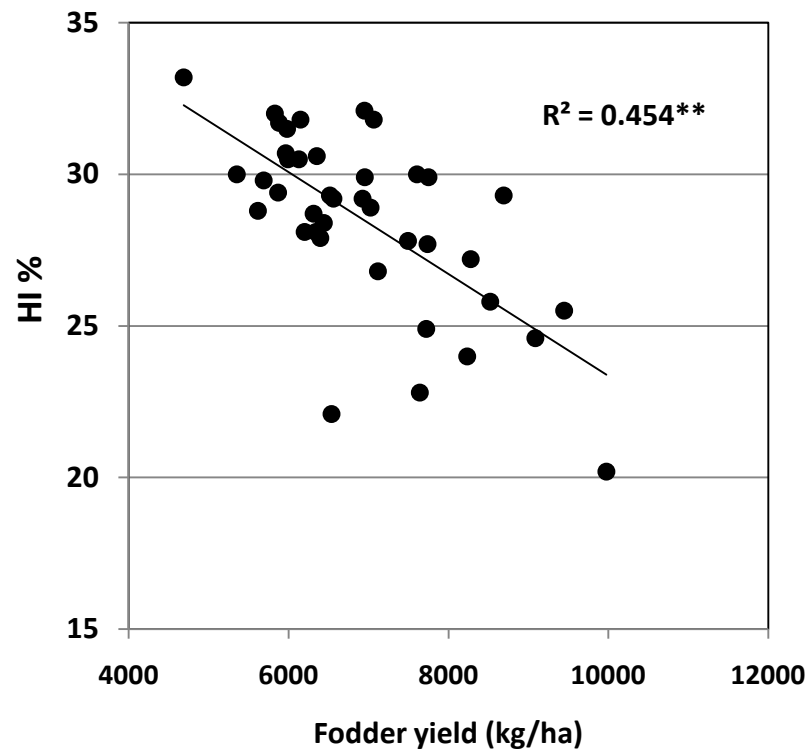
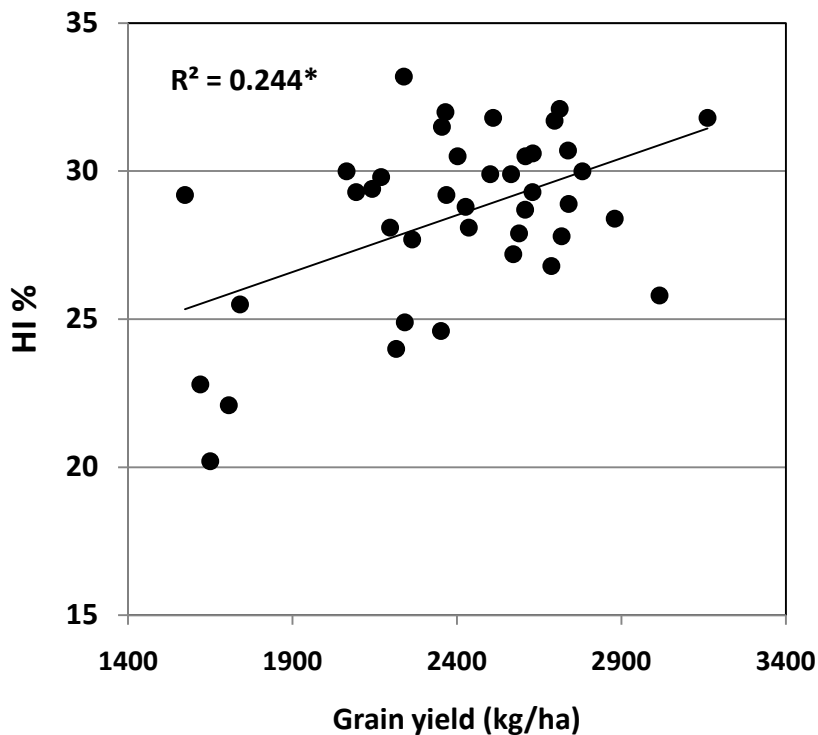
Landraces with high GY and FY

Genotype	GY (t/ha)	FY (t/ha)
SLV 181	2.63	8.69
BJV 125	3.01	8.52
RSV 1611	2.57	8.28
RSV 1772	2.78	7.61
SSRK 13-4	2.56	7.75
M 35-1	2.72	7.49

Highest GY was in Phule Suchitra (3.16 t/ha)

Highest FY was in SSRK 13-7 (9.98 t/ha)

Relationship of Harvest Index with GY and FY

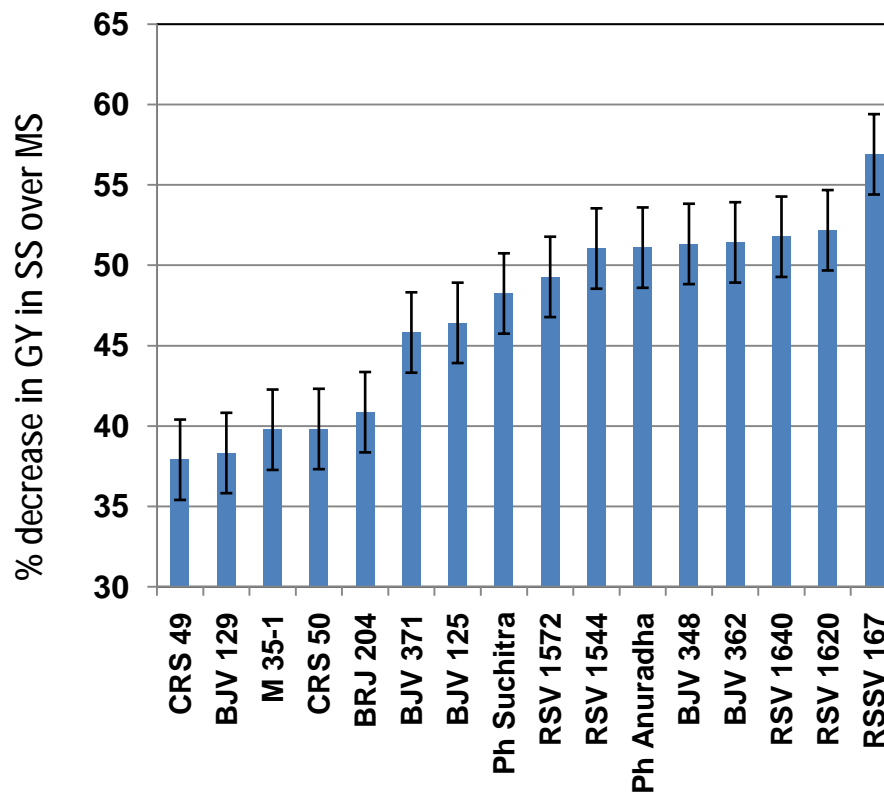


Significant positive relationship with Grain yield
Significant negative relationship with Fodder yield

Trial 2(M) & 3(S): Phenotyping advanced rabi sorghum entries for drought adaptation traits in medium and shallow soils

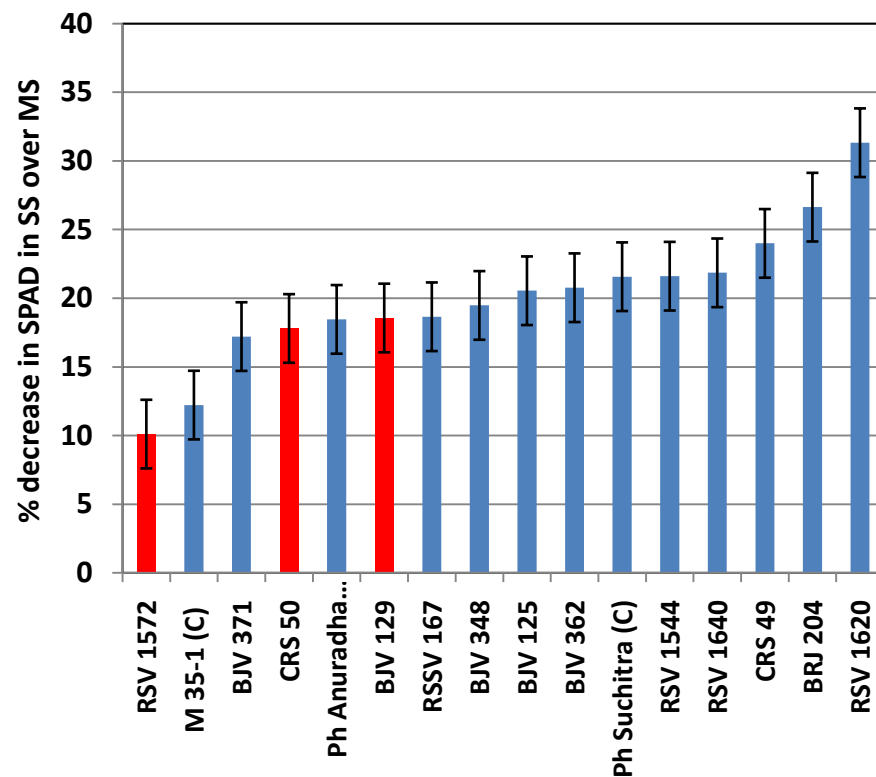
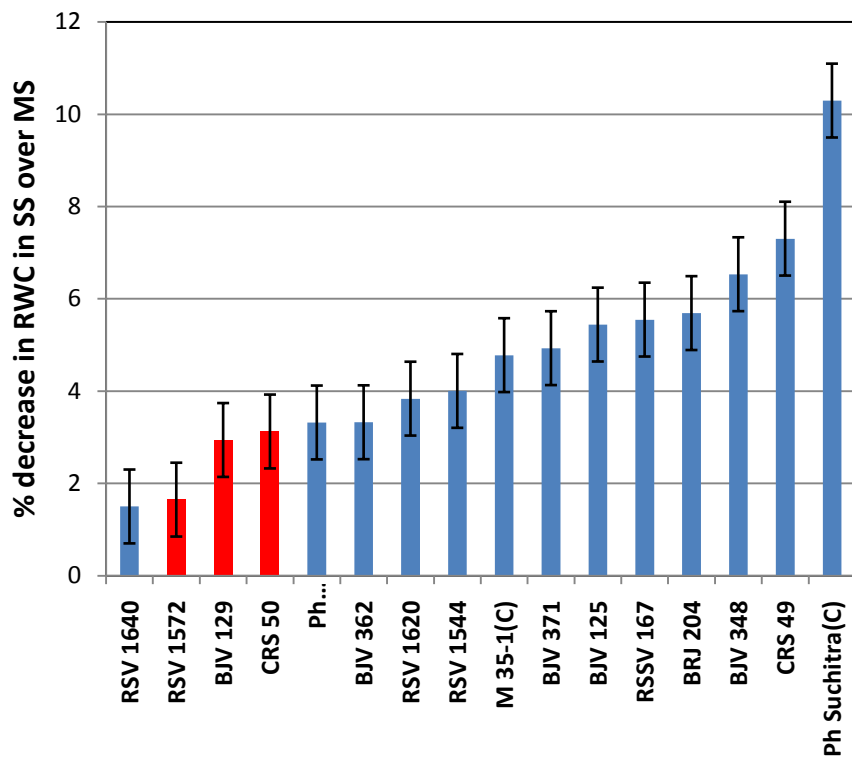
Obj: Identify the stable performing genotypes across soil depth

- 16 advanced (F_6 - F_7) genotypes phenotyped in MS & SS at five locations.
- Mean GY ranged from 2220 to 2965 & 809 to 2445 kg ha⁻¹ in MS & SS, respectively
- Decrease in GY in SS ranged 38-57% with minimum in CRS 49, BJV 129 & CRS 50.



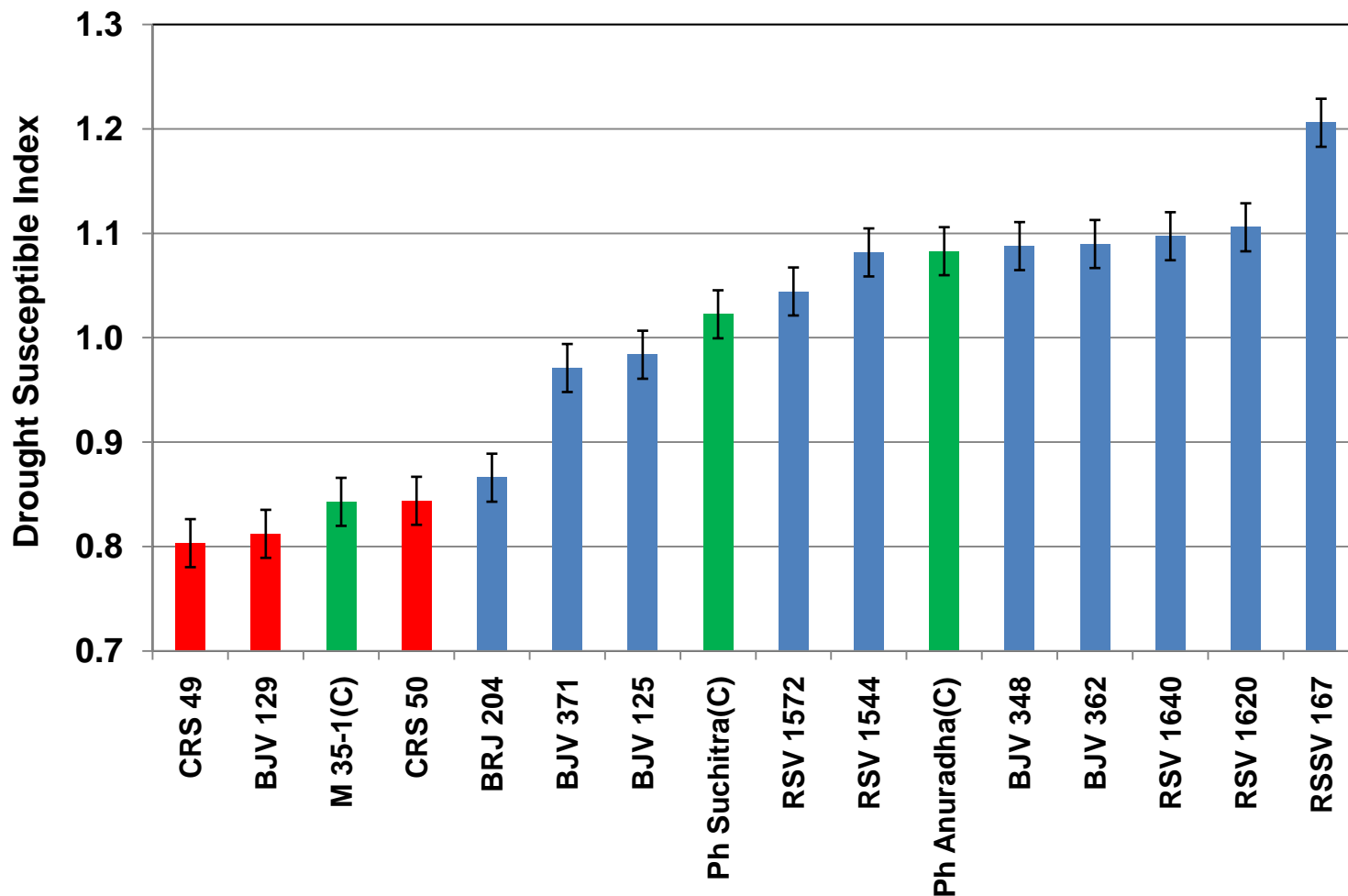
CRS 49, BJV 129 and CRS 50 are stable across soil depths

Change in plant water status (RWC) & Chlorophyll content in shallow soil over medium soil



- RWC decreased 2-11%, SPAD 10-32% in shallow soil
- RSV 1572, BJV 129 & CRS 50 are stable across soil depth

Drought susceptibility index (DSI) for grain yield (Mean; 4 loc; N=16)



CRS 49, BJV 129 and CRS 50 are stable across soil depths

Tr.4 R & 4 Irrg.: Variation in root traits in rabi sorghum as influenced by drought stress

Phenotyping facility for Root Traits - Rahuri

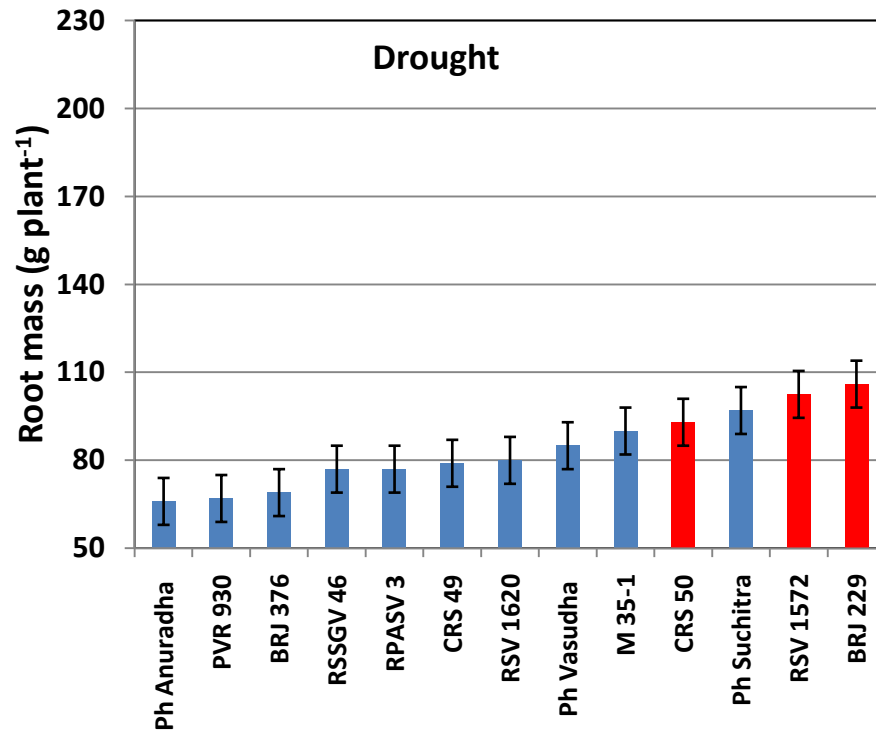
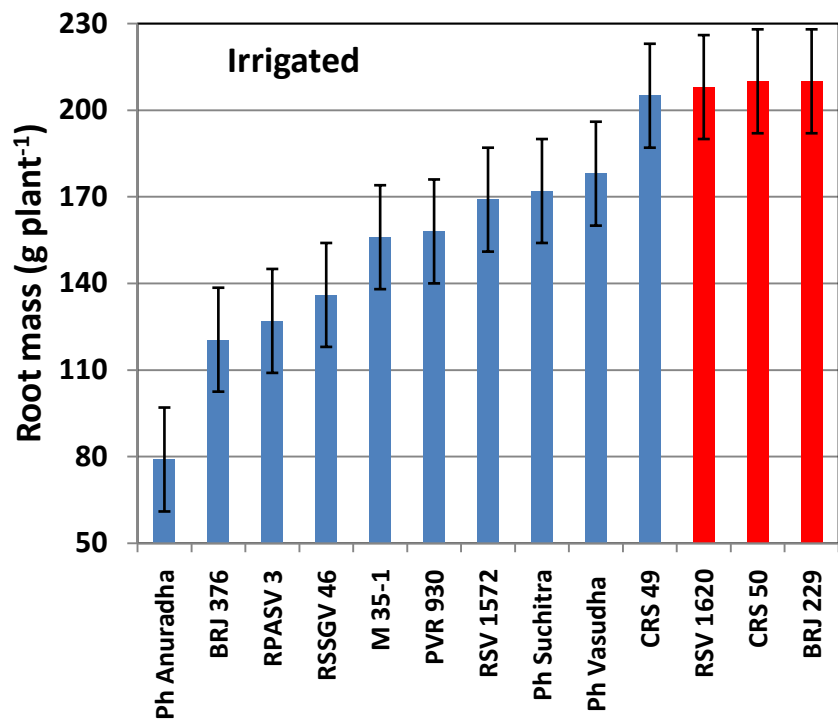


Variation in root traits in rabi sorghum as influenced by drought stress (N=13)

Root Trait (per Plant)	Range		Mean		Decrease in RF over irrig (%)
	IRRI	RF	IRRI	RF	
Root length (cm)	50-82	45-60	66	53	20
Root numbers	49-61	33-45	58	37	36
Root Biomass (g)	79-210	66-106	164	84	49
Root volume (cc)	73-158	43-98	119	76	36
Root: shoot ratio	0.52-0.90	0.43-0.86	0.71	0.54	22

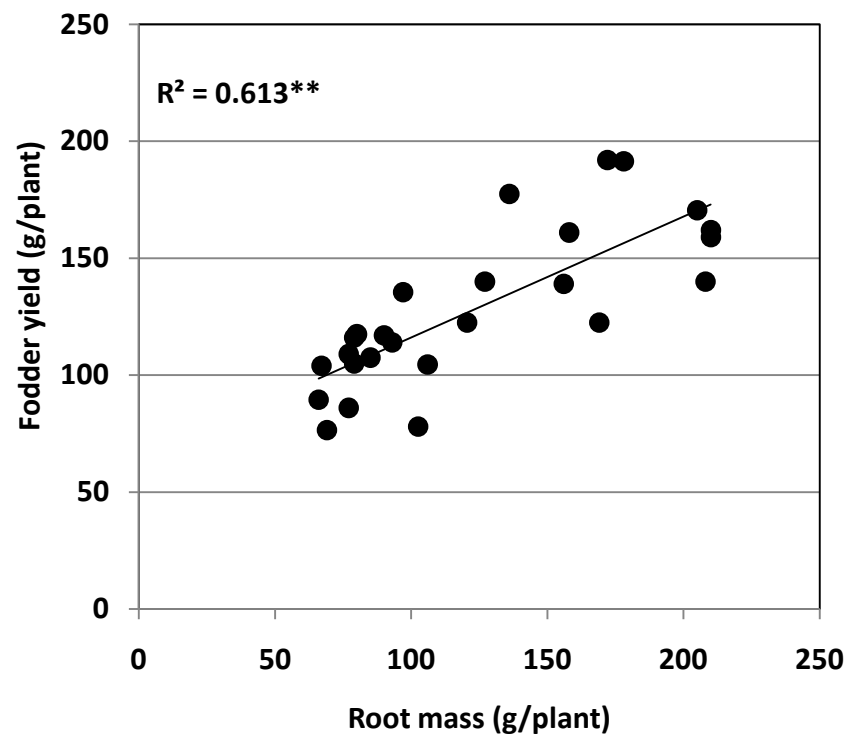
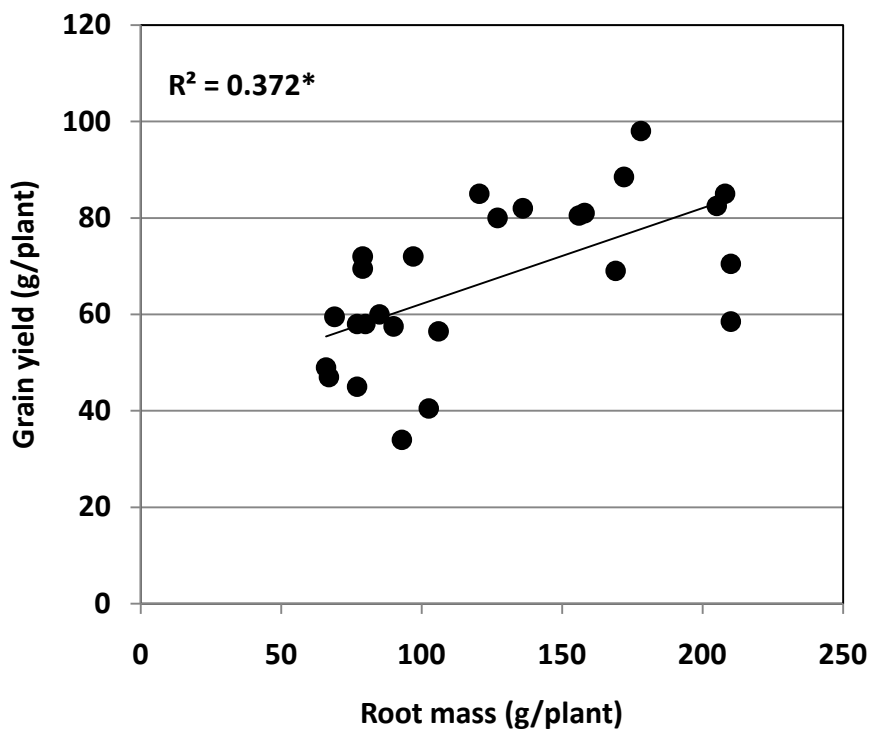
Overall promising: CRS 50, RSV 1572 & RSV 1620 for key root traits across moisture regimes.

Genotypic variations in Root mass under irrigated and drought



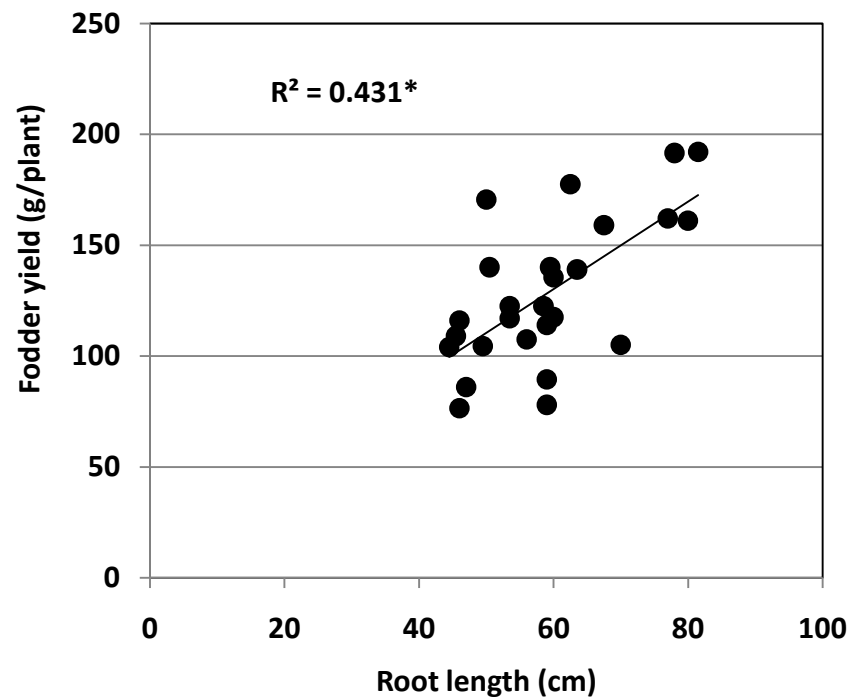
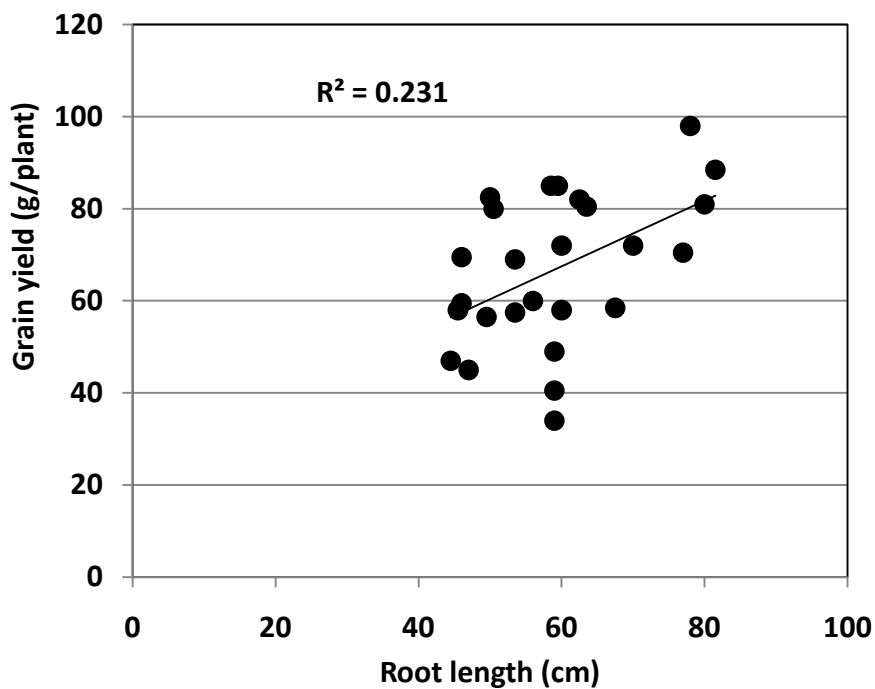
BRJ 229, CRS 50 & RSV 1572 – higher root mass under both wet & dry condition

Relationship of Root mass with Grain & Fodder yields



**Significant relationship between Root mass with both Grain & Fodder Yields
BRJ 229, CRS 50 and RSV 1572 – higher root mass under dry condition**

Relationship of Root length with Grain & Fodder yields



Significant relationship of Root length with Fodder Yield
CRS 50, RSV 1572 & RSV 1620 – higher root length under dry condition

Kharif sorghum phenotyping

1. Maintaining of higher Chlorophyll (SPAD values) leaf area & LAI at flowering explains the physiological basis of genetic gains in GY.
2. Improvement in seed size/weight explains most of the genetic variations among the released kharif cultivars evaluated.
3. Among the parental lines, AKMS 14 B- top B line & CB 33 top R lines for both GY & Biomass
4. Reduction in biomass was ranged from 6-85% under salinity. SVP 2457-6 %, SPV 2462 - 36%. Ionic ratio of K^+/Na^+ can be potential selection criteria.

Rabi Postflowering drought phenotyping:

1. SLV 181, BJV 125, RSV 1611, RSV 1772 & SSRK 13-4 germplasm lines with higher both GY and biomass. No single physiological parameter could explain the variations in yield traits.
2. Significant +ive relationship of HI with GY & -ive relationship with FY were recorded
3. CRS 49, BJV 129 & CRS 50 are stable across soil depths in GY and DSI. RSV 1572, BJV 129 & CRS 50 are stable in maintaining plant water status and Chlorophyll content across soil depths.
4. Significant relationship between of Root mass & Root length with both Grain & Fodder Yields. BRJ 229, CRS 50 & RSV 1572 were having higher both root mass and root length under DS .

Way-Forward

- Phenotype the new germplasm lines and advanced breeding lines for physiological and yield traits.
- Understand the physiological basis of genetic gains in yield components in already released kharif varieties /hybrids.
- Characterize the elite lines of sweet sorghum for salinity tolerance
- Understand the physiological basis of adaptation to different soil depths and identify the stable lines across soil depth in Rabi sorghum.
- Characterize the genotypes of advanced trials (AVT II & AHT II for physiological traits.
- Characterize the advanced genotypes for root traits.

Thanks for your attention!