

Fodder quality comparison in two sorghum populations under drought

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BACKGROUND

Digestibility and lignin content determines feed quality and plant fitness and are inversely related

A 5% variation in fodder digestibility is reported to result in a 20% price variation (Fig 1)

Sorghum is a dual-purpose crop grown in Asia and Africa

Compared to maize, it is drought tolerant and has high water use efficiency

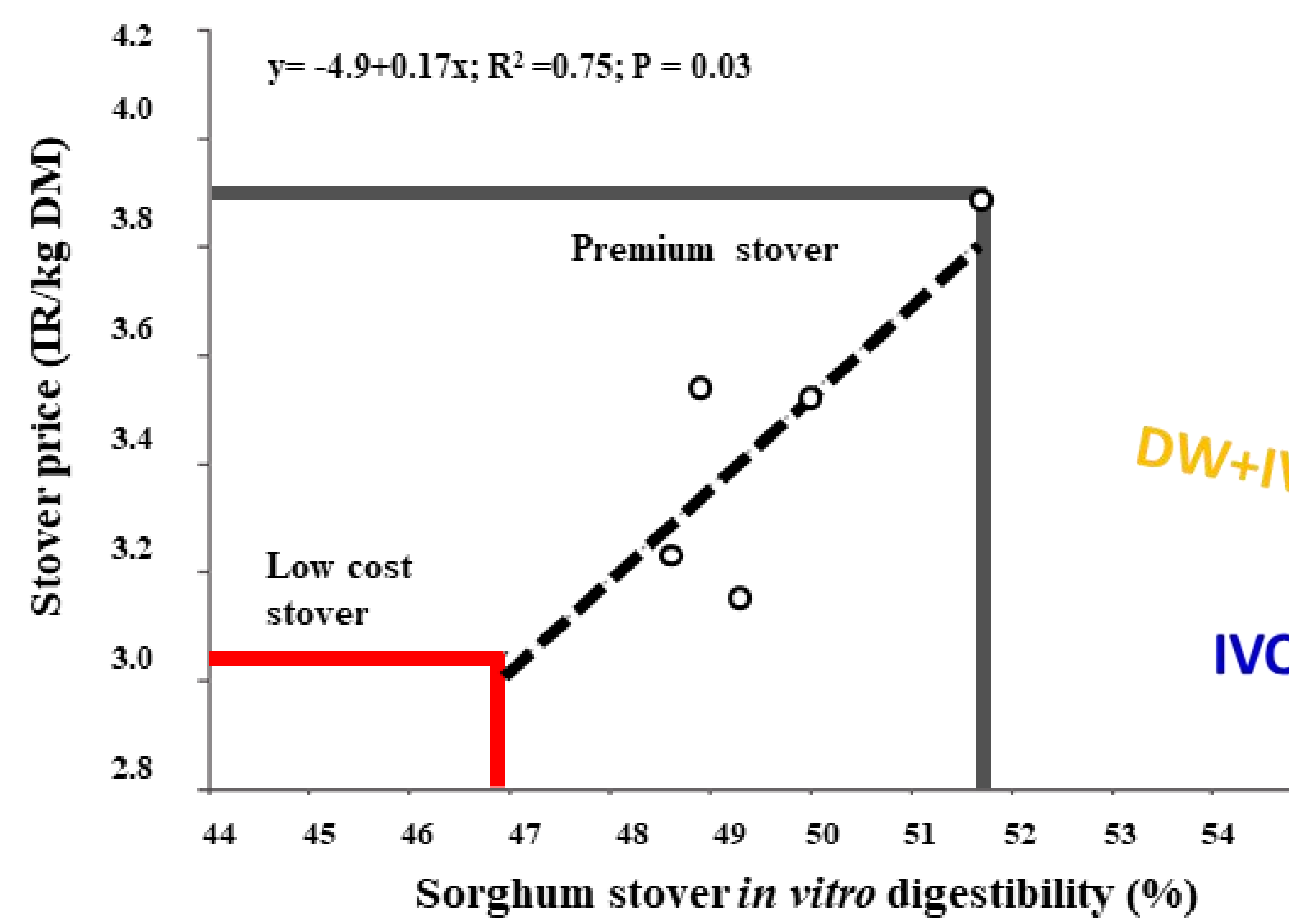


Fig 1: Relation between price and fodder quality

METHODS

A recombinant inbred line (RIL) population (n=320, cross between ICSV1xICSV700) and a subset from reference collection (n=130) were evaluated for terminal drought stress by withholding irrigation at boot leaf stage for both populations

Dry weight (DW) was recorded at maturity and the fodder was subjected to near infrared spectroscopy (NIRS) to record, nitrogen content on dry matter basis (NDM); neutral detergent fibre (NDF); acid detergent lignin (ADL); metabolizable energy (ME) and; *in vitro* organic matter digestibility (IVOMD).

ICIM software and rMVP (R package) were used to identify genomic regions associated with traits under study

Candidate genes from QTL mapping and significant SNPs from GWAS were identified by annotation with the reference genome and *Zea mays* in Phytozome and synteny plots generated in Circos

Pop	Trait	NDF	ADL	ME	IVOMD
REF	DW	0	0.04	0.07	0.07
	NDF		0.60**	-0.71**	-0.78**
	ADL			-0.75**	-0.75**
	ME				0.97**
RIL	DW	-0.07	-0.14*	0.28**	0.19**
	NDF		0.60**	-0.70**	-0.75**
	ADL			-0.79**	-0.79**
	ME				0.97**

Table 1: Correlation for fodder quality traits

RESULTS

Pearson's correlation across years and treatments for DW and IVOMD, showed negative correlation with NDF and ADL (Table 1)

While positive correlations were observed between DW, ME and IVOMD in the RIL population

However, in the reference set there was no strong positive or negative correlation between DW, ME and IVOMD

Sobic.008G026400 and *Sobic.010G229000* were identified for the RIL population while *Sobic.001G530300* and *Sobic.008G054500* were identified in the reference set under drought stress for IVOMD

Sobic.001G354800 was found to be associated with ADL, IVOMD and ME under drought stress, which is associated with seed - dry grain maturity

Dry weight in the RIL population was associated with *Sobic.007G145600* and *Sobic.007G146200* (both on chromosome7) involved in multiple pathways such as cell wall-bound phenolic acids that play a major role in plant defense against pathogens

ME in the reference set under stress was found to be associated with *Sobic.003G282600* gene linked to *homogalacturonan biosynthesis* with a role in the plant cell wall that contributes to plant growth and development and cell wall structure

The syntenic relation between sorghum and maize showed that *Sobic.007G023400* gene for IVOMD had 97.2% similarity with the maize gene *GRMZM2G134134_T02*, while *Sobic.009G206700* for DW exhibited 98.6% similarity with the maize gene *GRMZM2G319747_T02* (Fig 2)

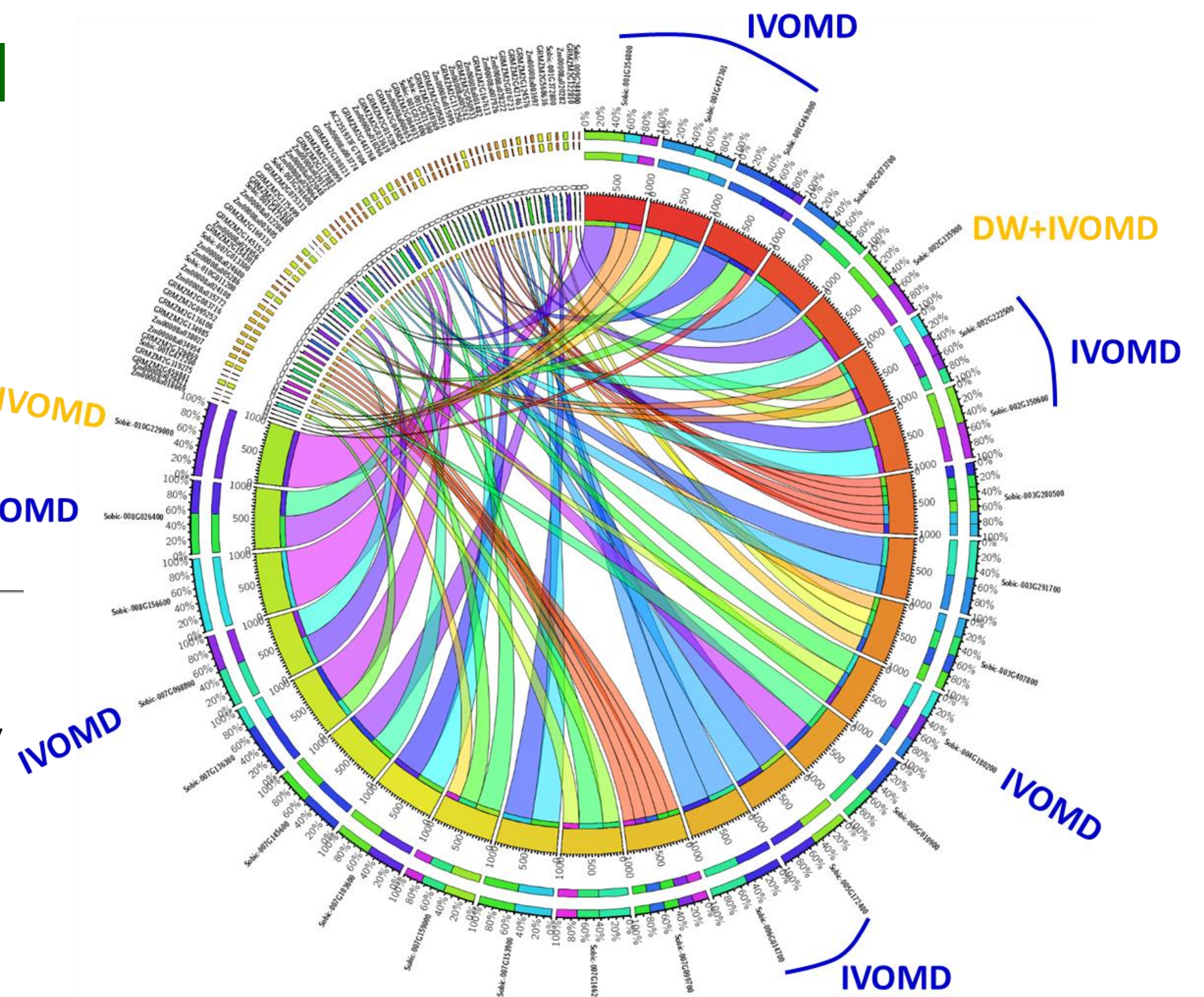


Fig 2a: RIL population-based QTLs and synteny with *Zea mays*

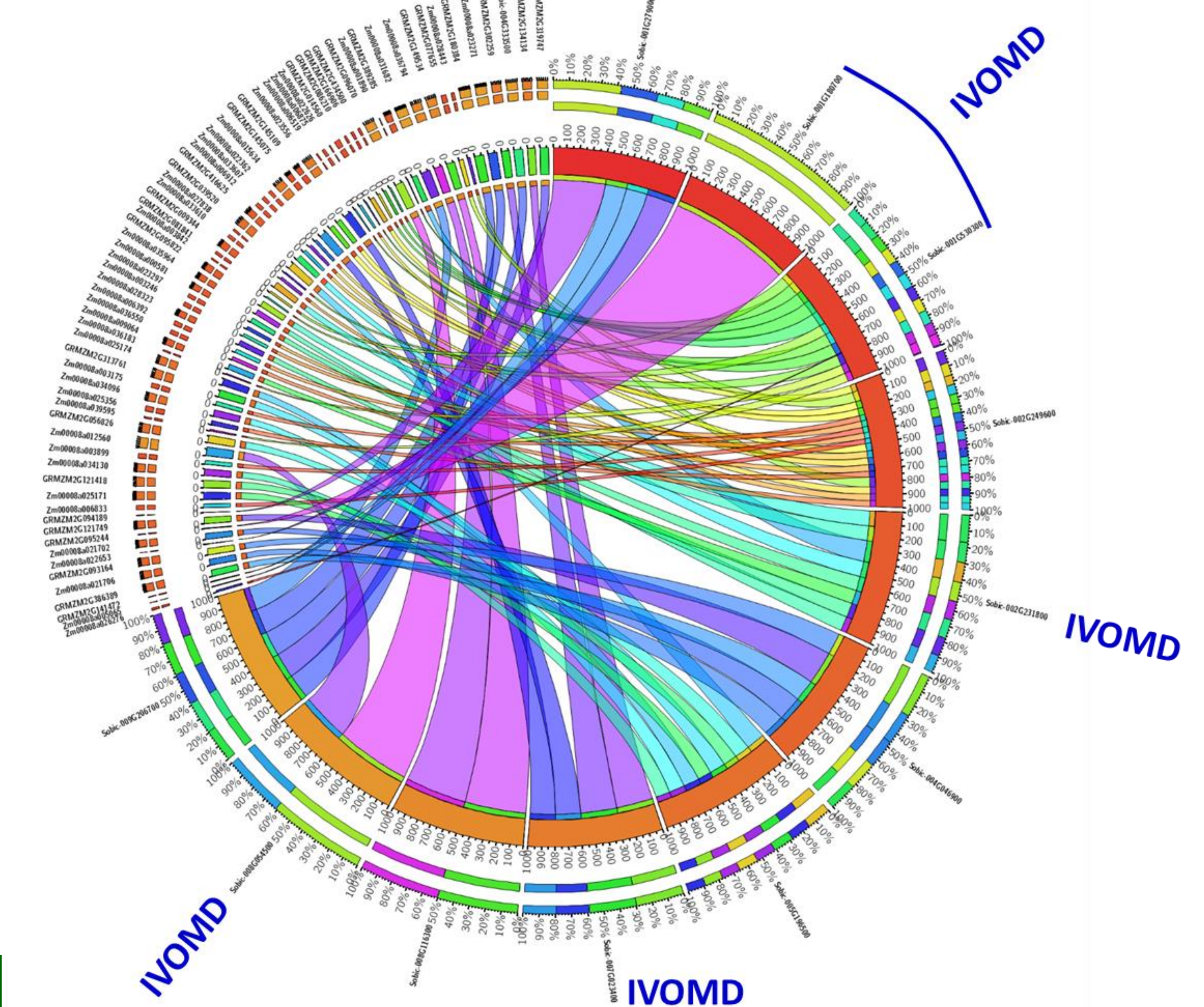


Fig 2b: MTAs based on Reference set and synteny with *Zea mays*

CONCLUSIONS

Concurrent improvement of dry weight and IVOMD in sorghum crop improvement is possible

A gene *Sobic.001G356000*, linked to lignin and metabolizable energy under stress conditions was identified as a putative candidate gene

Similarly, the gene *Sobic.001G463900* was linked to *in vitro* organic matter digestibility

Development of traits linked SNPs for breeding applications and fine mapping for IVOMD on chromosome 1 and 2 that will improve trait dissection is proposed