

Gene Modules Associated with Low Temperatures Response in Bambara groundnut

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Introduction

Bambara groundnut is a nutritionally rich, underutilised, indigenous African legume crop and mainly grown for its protein rich seeds. Low temperature (LT) can be a major abiotic stress and that can affected growth and yield of various crops. Similar to other crops, the growth and productivity of bambara groundnut also effected by LT stress in a number of ways, such as delays in the germination of seeds, a reduction in total dry matter (TDM), reduced shelling percentage and reduced seed and pod yields. Despite its importance as a promising food and economically valuable crop, there is a need to develop bambara groundnut varieties which are tolerant to low temperature stress could further improve the options for growth and productivity of this drought tolerant legume as part of sustainable low input agriculture. Therefore, in this study we made an attempt to identify gene modules associated with the LT stress under sub-optimal (23⁰ C) & very sub-optimal (18⁰ C) temperatures, respectively, which would provide a better understanding of the underlying molecular mechanisms of the LT response in bambara groundnut and then developing LT stress tolerant bambara groundnut varieties.

Results & Discussion

Analyses of the bambara groundnut transcriptome using cross-species gene expression data resulted in the identification of 375 and 659 differentially expressed genes ($p < 0.01$) under the sub-optimal (23⁰ C) and very sub-optimal (18⁰ C) temperatures, respectively, of which 110 genes are commonly shared between the two stress conditions. The construction of a Highest Reciprocal Rank-based gene co-expression network, followed by its partition using an Heuristic Cluster Chiseling Algorithm resulted in 6 and 7 gene modules in sub-optimal and very sub-optimal temperature stresses being identified, respectively. Modules of sub-optimal temperature stress are principally enriched with carbohydrate and lipid metabolic processes, while most of the modules of very sub-optimal temperature stress are significantly enriched with responses to stimuli and various metabolic processes (Figures 2 & 3). Several transcription factors (MYB, NAC, WRKY, WHIRLY & GATA) that may regulate the downstream genes involved in response to stimulus in order for the plant to withstand very sub-optimal temperature stress. The identified gene modules could be useful in developing low-temperature stress tolerant bambara groundnut varieties

Conclusion

The identified gene modules and genes (Transcription factors) could be useful in developing in low-temperature stress tolerant bambara groundnut varieties, via analysis of the existing genetic diversity available within bambara groundnut, through germplasm collections, such as that held at the International Institute for Tropical Agriculture in Nigeria.

Methodology

Figure 1 shows the developed computational pipeline.

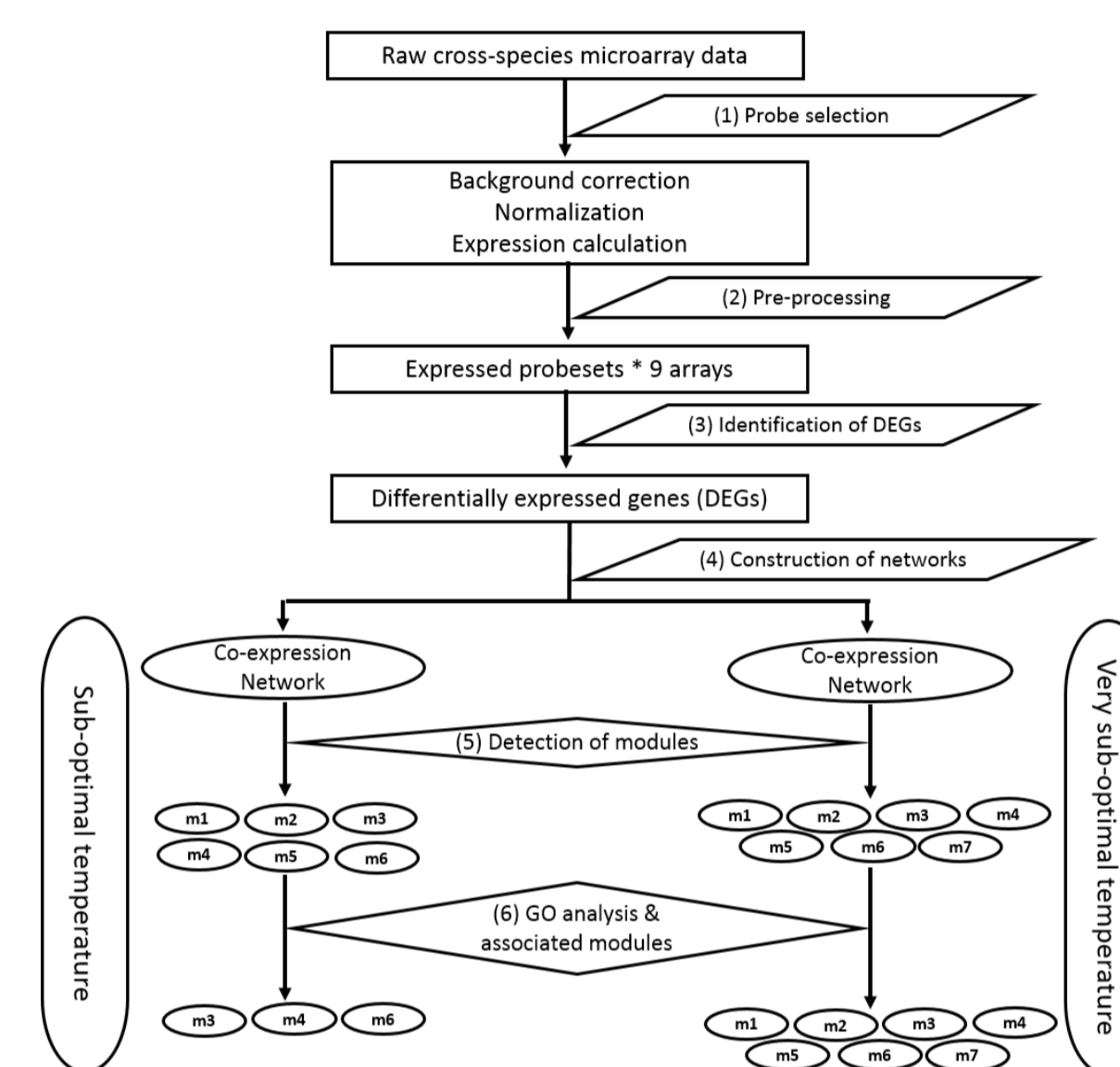


Figure: 1

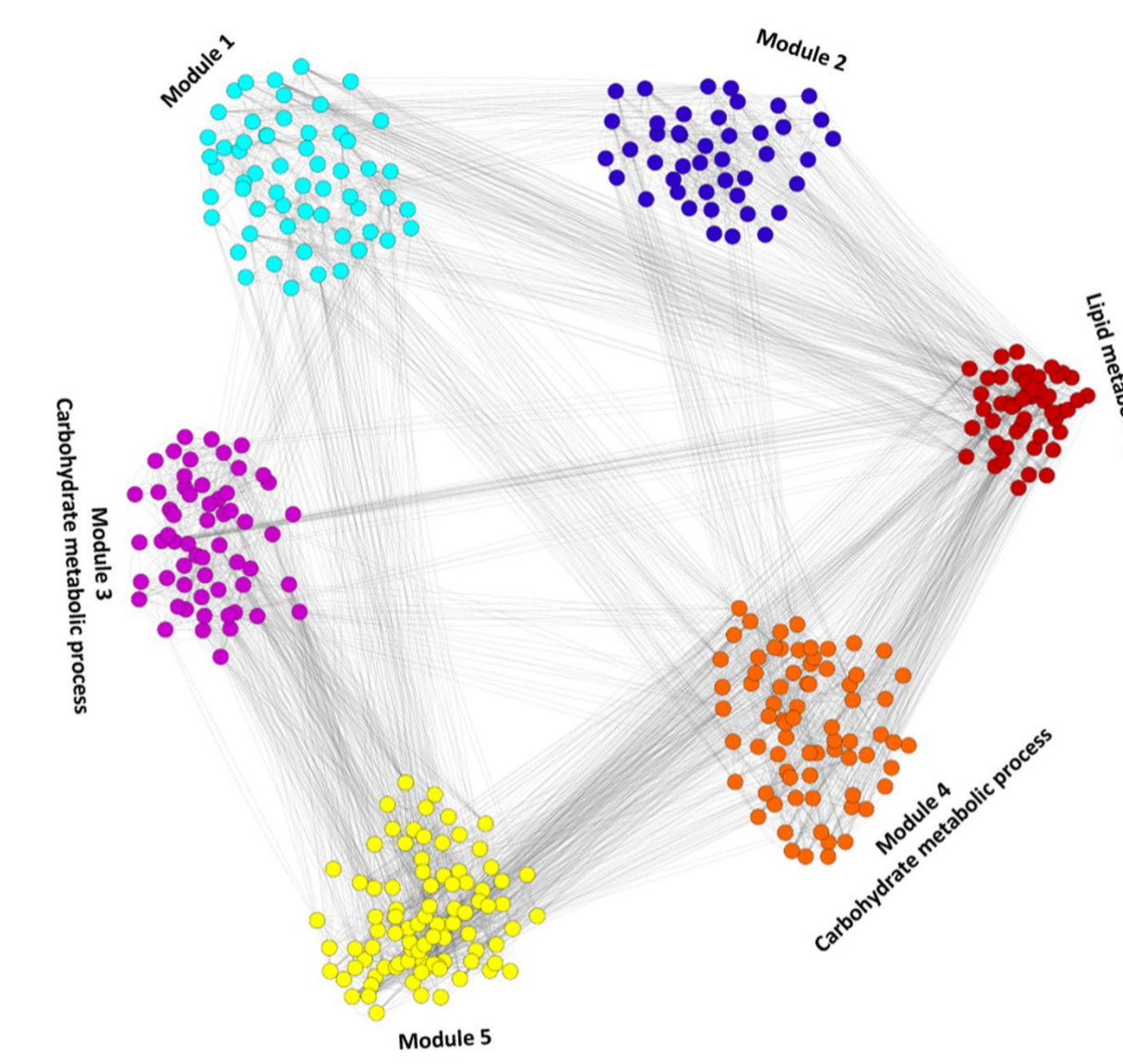


Figure: 2

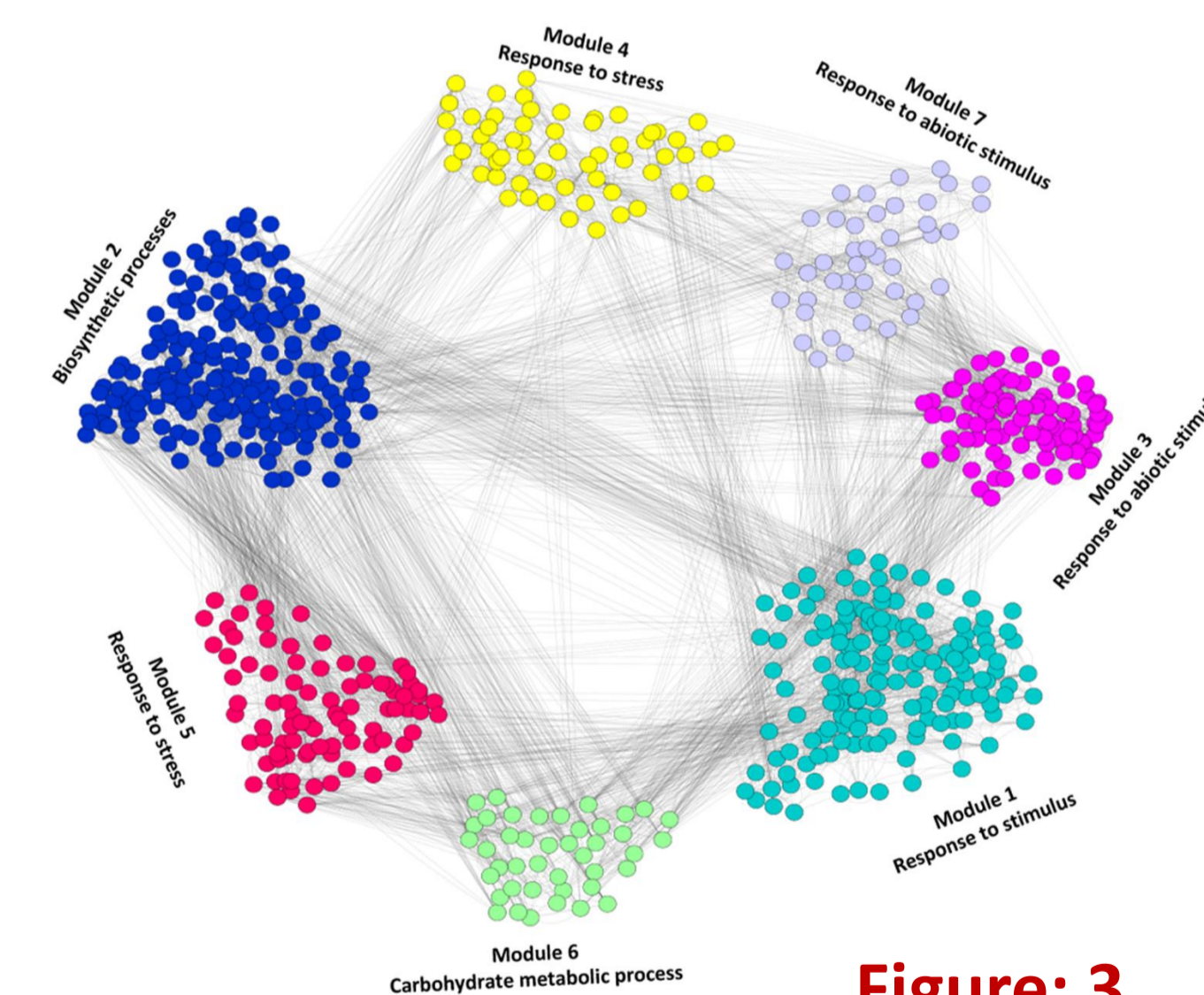


Figure: 3

References

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