Salt tolerance and molecular genetic diversity analysis in chickpea (*Cicer arietinum* L.) from Ethiopia

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Introduction

- Chickpea is a cool-season legume crop.
- It is grown mainly for its nutritional, agricultural, and economic benefits in Ethiopia.
- Its production is affected by biotic and abiotic factors.
- Soil salinity is the amount of water-soluble salts, mainly sodium, in the soil[1].
- Agricultural productivity is increasingly being threatened by soil salinity[2].
- Chickpea breeding and conservation efforts require the identification of salt-tolerant variants.

Objectives

i. Identify salt-tolerant chickpea accessions, ii. Analyze the molecular genetic diversity

Methodology

- 107 chickpea samples of which 69 accessions, 18 released varieties, and 20 wild types were used.
- Percent reduction in total dry matter used to classify salt tolerance.

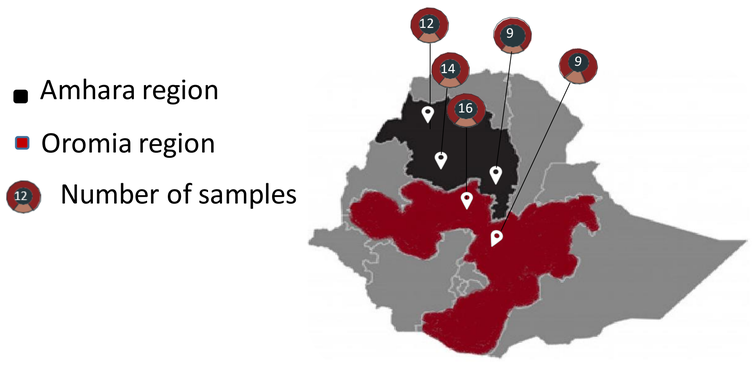
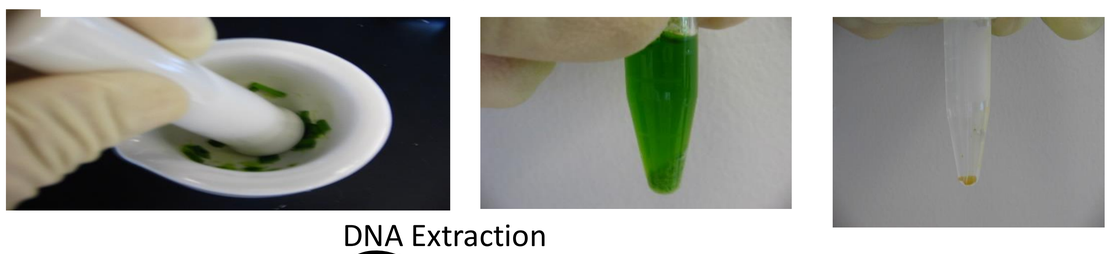


Fig. 1. Sample collection sites, Ethiopia

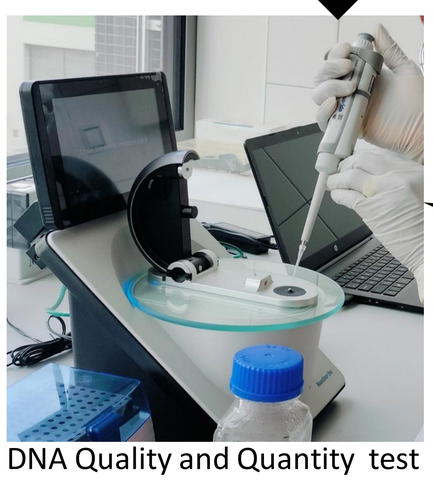
Hydroponic screening

Seed surface sterilization → Germination → Transferring to Hoagland nutrient solution → Salt treatment (15 days with 100mM NaCl) → Measuring growth parameters

Genetic diversity analysis using Inter Simple Sequence Repeat (ISSR) Marker



DNA Extraction



DNA Quality and Quantity test

PCR Amplification

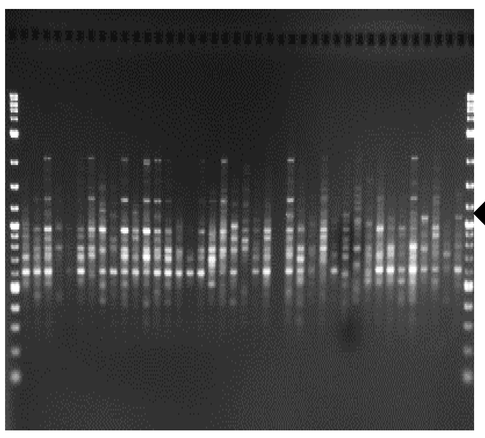
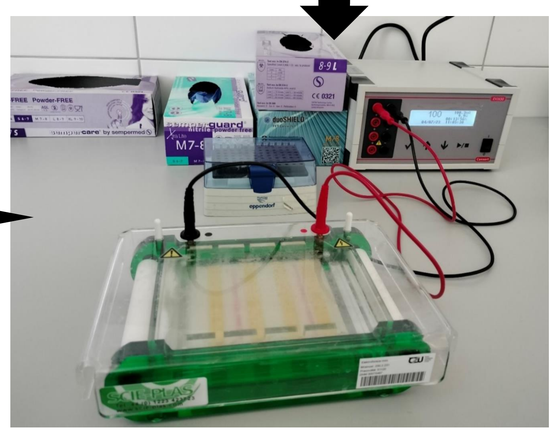


Image Documentation



Gel electrophoresis

Result

Salt tolerance screening

- Salt Tolerant: 4 accessions (41119, 41164, 207656 and Minjar)
- Moderately tolerant: 39 accessions
- Moderately sensitive: 44 accessions

Molecular diversity analysis

- 95% within populations variation
- High gene flow (Nm= 5.46)
- Low genetic differentiation (*G*st=0.08)

Table 1. Genetic diversity of tolerant and moderately tolerant accessions

Population	NPL	PPL	Na	Ne	H	I
North West Amhara	172	77.48	1.77±0.42	1.52±0.37	0.30±0.19	0.44±0.27
East Gojam	163	73.42	1.73±0.44	1.49±0.38	0.28±0.20	0.41±0.27
North Shewa	137	61.71	1.62±0.49	1.40±0.40	0.23±0.21	0.31±0.29
West Shewa	164	73.87	1.74±0.44	1.49±0.38	0.28±0.20	0.41±0.28
East Shewa	168	75.68	1.76±0.43	1.54±0.39	0.30±0.20	0.43±0.28
Released Varieties	182	81.9	1.66±0.47	1.42±0.39	0.24±0.20	0.36±0.28

NPL= Number of polymorphic loci, PPL=Percent polymorphic loci, Na=Observed number of alleles, Ne= Effective number of alleles, H= Nei's gene diversity, I= Shannon information index

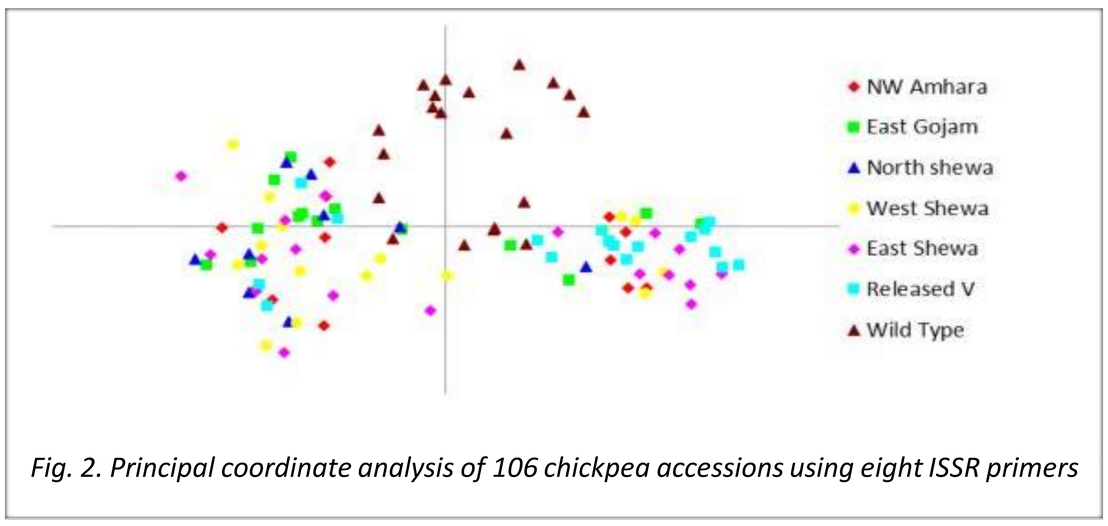


Fig. 2. Principal coordinate analysis of 106 chickpea accessions using eight ISSR primers

Conclusion

- The four salt-tolerant accessions as well as the East Shewa and North West Amhara populations are promising prospects for advancing salt tolerance breeding program.
- The wild chickpea accessions could be exploited to improve the genotypes of cultivated chickpeas.

Acknowledgments

We are grateful to the Microbial, Cellular, and Molecular Biology Department of Addis Ababa University for providing laboratory facilities, the Partnership for Enhanced Engagement in Research (PEER) project, and Pan African University (PAU) for funding.

References

[1]Karthika, G. & Govintharaj, P. in Climate Change and Crop Stress 1-32 (Elsevier, 2022).,[2]Majeed, A. & Muhammad, Z. Salinity: a major agricultural problem—causes, impacts on crop productivity and management strategies. Plant abiotic stress tolerance: Agronomic, molecular and biotechnological approaches, 83-99 (2019).

Partnerships for Enhanced Engagement in Research (PEER)

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