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BioGARD

Evaluation of Ethiopian durum wheat (*Triticum turgidum* L. var. *durum*) genotypes for drought tolerance at varying sowing density

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Background

- Climate extreme events have become common, particularly droughts and floods.
- These events are pronounced and increased in countries such as Ethiopia in the last ten years relative to the decade before[1].
- Drought is a leading abiotic factor responsible for the reduction in wheat production world wide and particularly in Ethiopia.
- Thus, understanding the fundamental mechanism of drought response in major crops such as wheat is paramount for meaningful crop improvement [2].
- In this study, we aimed to identify promising Ethiopian durum wheat genotypes that are better adapted to drought at varying sowing density under greenhouse condition.

Materials and Methods

- A factorial combination of 2 moisture regimes (MR) × 2 sowing densities (SD) × 15 genotypes (G)× 6 replicates = 360 experimental units, Design: CRD.
- Two MR i.e. 80% of field capacity (FC) (control) and 30% of FC (stress), soil moisture content at FC was 36.5% (v/v).
- Two SD: 5 per bucket and 50% more (8 per bucket) were considered.
- Drought was induced from stem elongation stage (BBCH 31) till physiological maturity.
- Data collected were subjected to analysis using SAS software version 9.4. Graphs was plotted by SigmaPlot V.10.
- Proc Mixed procedure was pursued considering G and MR as fixed effect while SD as random effect.

Results

Table 1.Analysis of variance (ANOVA) of Ethiopian durum wheat genotypes grown under different moisture regimes for growth and yield and yield related attributes

Source of variation	No. DF	SN _Sg.root F-value	SN _Sg.root Pr>F	TLAPP (cm^2) F-value	TLAPP (cm^2) Pr>F	NGPS F-value	NGPS Pr>F	BYPP (g) F-value	BYPP (g) Pr>F	GYPP (g) F-value	GYPP (g) Pr>F	SLA (cm^2g^{-1}) F-value	SLA (cm^2g^{-1}) Pr>F
Moisture regimes (MR)	1	11.17	0.0022	12.98	0.0004	215.16	<0.0001	127.50	<0.0001	52.27	<0.0001	1.84	0.1768
Genotypes (G)	14	1.26	0.2889	1.58	0.0894	3.39	<0.0001	6.00	<0.0001	2.80	0.0010	1.22	0.2661
MR × G	14	0.45	0.9420	1.16	0.3101	2.89	0.0007	1.44	0.1414	3.41	<0.0001	1.12	0.3449

Growth, yield and yield related traits. No.DF, number of degree of freedom; SN Sq.root, the square root of stomata number; TLAPP, total leaf area per plant ; NGPS, Number of Grains per Spike; BYPP, Biomass Yield per Pot in Grams; GYPP, Grain Yield per Pot in grams, and specific leaf area (**cm^2g^{-1}**).

Table 2. Main effect of moisture regimes and genotypes for stomata number, leaf area per plant and biomass yield

Moisture regimes	SN_ sq. root	Total leaf area per plant (cm^2)	BYPP (g)
80% of FC	7.04 ± 0.21^{b}	16.06 ± 0.95^{a}	4.30 ± 0.08^{a}
30% of FC	8.14 ± 0.24^{a}	9.84 ± 0.61^{b}	2.40 ± 0.06^{b}
Tukey's HSD	**	***	***
Genotypes			
G1 (Kilinto) #	6.94±0.18	9.20±1.74	3.31 ± 0.30^{ab}
G2 (Fetan)	6.86±0.55	11.15±2.16	3.13 ± 0.38^{bc}
G3 (Selam)	7.09±0.81	14.73±2.01	3.94 ± 0.46^{a}
G4 (Metaiya)	8.23±0.10	19.46±2.76	3.62 ± 0.39^{ab}
G5 (Bakelcha)	8.43±0.74	13.39±3.34	3.56 ± 0.32^{ab}
G6 (Denbi)	7.81±1.14	14.77±1.78	3.10 ± 0.32^{bc}
G7 (Bichena)	6.96±0.50	8.79±1.24	3.56 ± 0.34^{ab}
G8 (Alem-Tena) ##	7.58±0.82	13.95±2.18	3.13 ± 0.27^{bc}
G9 (Hitosa)	7.09±0.75	15.95±2.49	3.44 ± 0.27^{ab}
G10 (Arsi-Robe)	8.28±0.65	5.97±0.54	2.56 ± 0.23^{c}
G11 (Ejersa)	9.29±0.76	16.57±2.81	3.28 ± 0.35^{abc}
G12 (Boohai)	7.78±0.38	18.70±2.31	3.68 ± 0.40^{ab}
G13 (Flakit)	6.80±0.64	7.31±1.51	3.13 ± 0.32^{bc}
G14 (Mangudo)	7.51±0.44	11.26±2.24	3.09 ± 0.25^{bc}
G15 (Malefia)	7.23±0.58	12.90±1.84	3.95 ± 0.36^{a}
Tukey's HSD	ns	**ns**	***

Stomata number value was transformed using square root transformation. Mean ± (Standard error), values with different superscripted letters are significantly different according to Tukey's HSD test ($P < 0.05$). ns, not significant; $*P < 0.05$; $**P < 0.01$; $***P < 0.001$. ##drought tolerant check; #drought susceptible check.

Note: Genotypes marked in green proved to show the least drought effects in terms of yield reductions.

Figure 1. Stomata measurement images for drought tolerant genotype e.g. in Alem-Tena (G8).

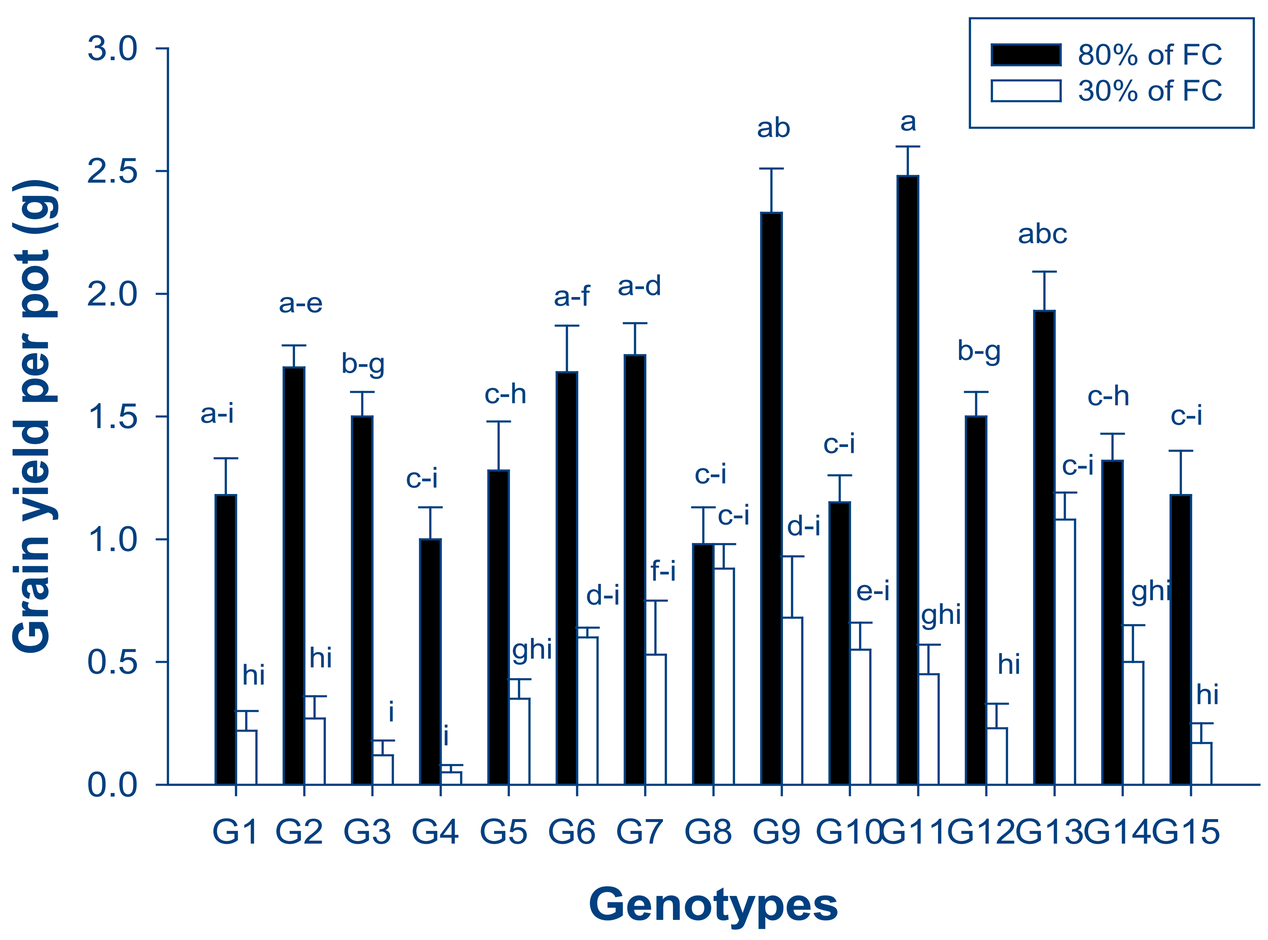

Figure 2. Variation of grain yield of Ethiopian durum wheat genotypes under different moisture regimes. Different letters indicate significant differences among genotypes across different moisture regimes according to Tukey's HSD test ($P < 0.05$).

- We found that drought had significantly affected most of the parameters studied, including stomata number.
- Variability in grain yield across different moisture regimes was observed, but the response patterns remained the same across genotypes.
- Hence, it will be worthwhile to use combinations of traits to screen and advance genotypes for the next detailed eco-physiological study.

Conclusion

Based on preliminary evaluations, the six best thriving genotypes were selected for further testing in climate chamber experiments.

References

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Acknowledgements

I would like to express my warm appreciation and put on record my heartfelt gratitude to the FSC/CLIFOOD project for funding my PhD. I would also like to thank both University of Hohenheim and Hawassa University for hosting me to do my research work.

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