Identification of stable and high yielding heat tolerant maize hybrids and associated secondary traits

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Introduction

- Africa :Staple crop and >300million people depend on maize as their main food

- Production : 2t/h VS 5.5t/h for the world

- Impact of climate change has already shown huge negative effects in Zim.

Heat stressed maize crop

Introduction..

- Drought and heat major abiotic stresses

- Leading issue for climatic vulnerability is now heat stress

- Heat stress can occur abruptly and even short episodes cause a severe decline in grain yield

- An increase in temperature by 2^0C reduces GY by 13%

Justification

- Heat stress has affected suitability of existing maize varieties in Zimbabwe
- High yielding heat stress tolerant varieties becomes a priority
- GY is the primary trait for selection in many breeding programs

- GY ~ low H^2 and high G× E under stress environment
- Selection for GY alone under stress may not be effective.

Objectives

Main Objective

- To identify stable and high yielding heat tolerant maize hybrids and associated secondary traits.

Specific Objectives

- To identify stable and high yielding heat tolerant maize hybrids under heat and non-stress conditions.

- To identify secondary traits associated with maize grain yield under heat stress.

Materials and methods

- **Germplasm** : (5 HT lines x 12 lines) - 60 entries (56 hybrids, Heat tolerant hybrids; 4 local` checks)

- **Design** : 6 x 10 alpha lattice,

- **Location :**

Location	GPS	Purpose
Chisumbanje	20.76’84° S, 32.2285° E	Heat stress
Muzarabani	16.20’00° S, 31.1000° E	Heat stress
Harare	17.82’52° S, 31.0335° E	Optimum

- **Data collected**: AD, SD, ASI, EH, PH, LDG, NE, SEN & GY

Data analysis

- ANOVA across environments for GY and other traits carried out using GenStat 14th Edition.

- Varieties = fixed factors; Environments = random factors.

- Variance components were estimated with REML

- $H^2 = \sigma^2 g / \sigma^2 p$ where $\sigma^2 p = \sigma^2 g + \sigma^2 ge/e + \sigma^2 e/e$

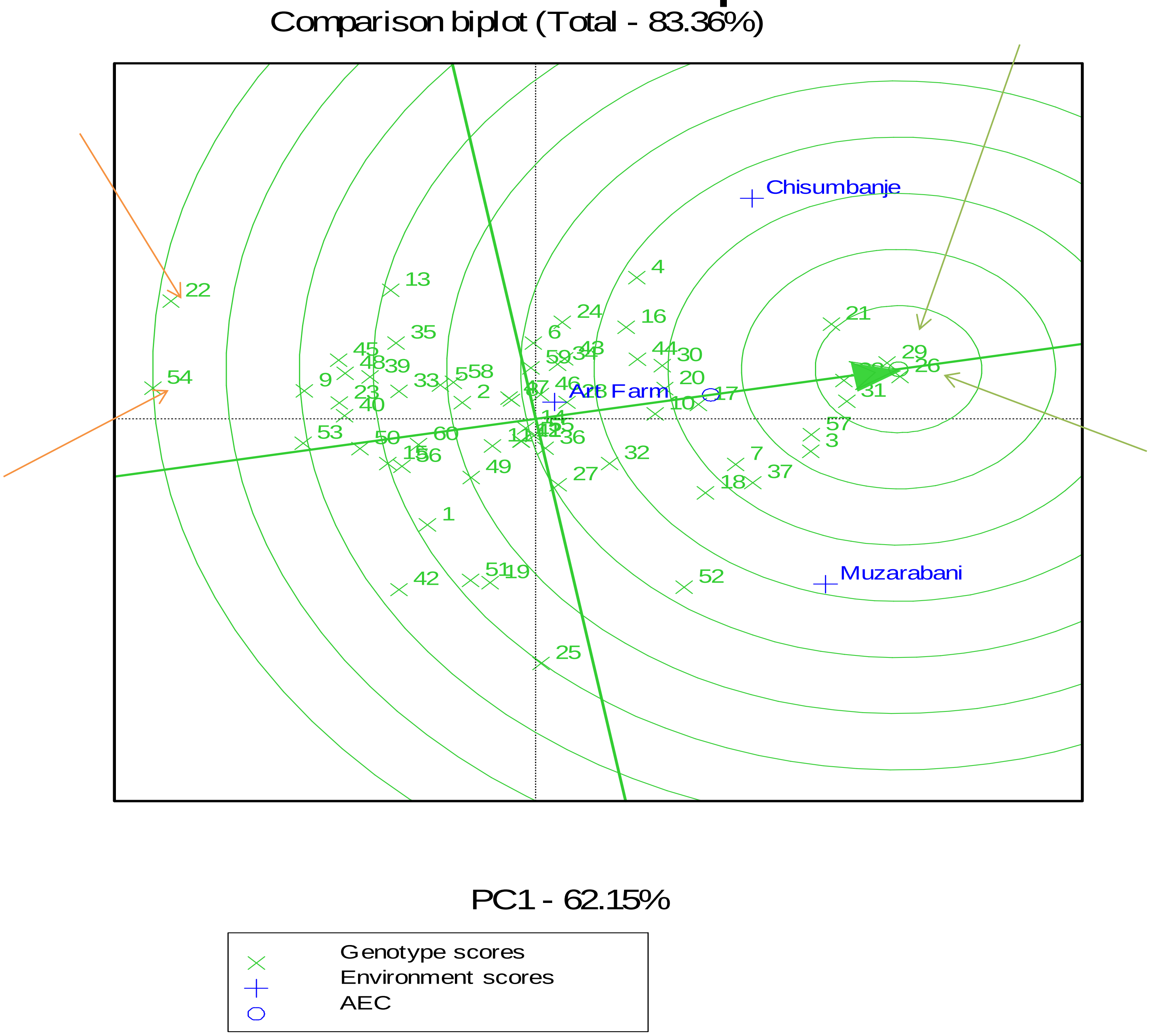
- GGE: Stability analysis

- Phenotypic correlation: → Grain Yield ~ Secondary traits

Results - ANOVA across Environments

Source of variation	D.F	GY	AD	ASI	EH	LDG	NE	PH	SD	SEN
Site	2	1659.72	10793	94.872	142500	316.65	9872	315602	10988	8305.14
Site.Rep	6	11.33	9.67	2.49	499.60	7.65	64.78	1311.70	7.71	92.73
Site.Rep.Bloc	126	7.33	10.49	2.13	231.10	17.92	95.19	373.10	10.09	125.98
NP	1	17.96	6.09	0.02	803.30	0.04	1493	119.20	0.90	16.80
Entry	**59**	**6.33****	**21.72*****	**3.54*****	**400.20*****	**8.81ns**	**86.71ns**	**342.20***	**25.05*****	**289.81*****
Site.Entry	**118**	**3.43*****	**3.28*****	**1.73*****	**177.50ns**	**10.78*****	**91.78ns**	**223.50****	**4.74*****	**68.73*****
Residual	227	1.98	1.67	1.01	143.30	5.69	84.97	152.70	2.11	40.64
Total	539	10.31	46.42	2.07	732.90	11.17	127.70	1423.80	47.89	125.21
P value		**<.001**	**<.001**	**<.001**	**<.001**	**0.013**	**0.445**	**<.001**	**<.001**	**<.001**
Heritability		**0.46**	**0.85**	**0.51**	**0.46**	**0**	**0**	**0.35**	**0.81**	**0.76**

Results –GGE Biplot



Results: Ranking

	Ranking	Entry	GY	AD	ASI	EH	LDG	NE	PH	SD	SEN
Top 5	**1**	**29**	**11.34**	**66.75**	**0.88**	**110.60**	**0.57**	**31.36**	**205.9**	**66.69**	**63.63**
	2	**26**	**11.32**	**69.58**	**0.88**	**116.90**	**4.41**	**30.46**	**207.8**	**68.92**	**51.48**
	3	57	10.97	66.59	1.59	106.60	1.10	32.51	212.3	65.82	59.4
	4	7	10.70	67.44	1.81	119.70	-0.50	31.65	209.6	67.58	54.17
	5	21	10.62	66.24	0.83	108.20	3.18	32.8	212.9	65.96	43.58
Bottom 5	56	45	7.90	67.93	1.88	105.40	0.81	33.04	185.4	67.91	56.97
	57	22	7.70	69.03	0.84	117.20	3.92	32.56	201.4	68.98	59.13
	58	50	7.64	71.76	2.55	113.90	1.52	32.82	198	72.34	58.55
	59	22	7.44	73.24	3.08	130.50	1.34	27.24	216.8	73.23	55.24
	60	54	6.92	72.48	2.66	125.60	1.48	27.38	212	72.78	62.95
MSE			1.99	1.67	1.01	143.30	5.68	84.97	152.7	2.11	40.64
Grand mean			9.12	68.04	1.45	114.71	1.86	30.97	206.54	67.94	58.66
SD			1.41	1.29	1.01	11.97	2.38	9.22	12.36	1.45	6.37
LSD			0.92	0.84	0.66	7.82	1.56	6.02	8.07	0.95	4.16
CV			15.48	1.90	69.37	10.43	128.26	29.76	5.98	2.14	10.87

Results – Phenotypic Correlations

Trait	GY	LDG	NE	NP	PH	SD	SEN	AD	ASI	EH
GY	-									
LDG	-0.06	-								
NE	0.10	-0.07	-							
NP	-0.03	0.12	-0.08	-						
PH	-0.06	-0.02	-0.12	-0.15	-					
SD	**-0.65***	-0.16	0.04	-0.05	0.09	-				
SEN	**-0.43***	-0.04	0.01	-0.14	0.06	0.07	-			
AD	**-0.57***	-0.06	-0.01	-0.13	-0.02	0.88***	0.02	-		
ASI	**-0.46***	-0.23	0.10	0.09	0.20	0.70***	0.13	0.28*	-	
EH	**-0.27**	-0.02	-0.01	-0.10	0.65***	0.50***	-0.02	0.40**	0.40**	-

Conclusions and Recommendations

- Stable and high yielding varieties under heat stress were 29(15H29) and 26 (15H26)

- These varieties are recommended for release and production in heat stress environments

- These secondary traits (AD, SD, ASI and SEN) may strongly be recommended for indirect selection for GY under heat stress

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