Variation in Phenological Development and Yield Performance of Rice Genotypes under Cold Stress in the Fogera Plain, Ethiopia

Bayuh Belay Abera[1], Marc Cotter[1], Kalimuthu Senthilkumar [2] and Folkard Asch[1]

[1] Institute of Agricultural Science in the Tropics (Hans-Ruthenberg-Institut), Management of Crop Water Stress in the Tropics and Subtropics (490g), University of Hohenheim;
[2] Africa Rice Center, Africa-wide Agronomy Task Force

Introduction

Rice is the most rapidly growing food source in sub-Saharan countries. Rice cultivation is a recent phenomenon in Ethiopia. The national average rice productivity is estimated to be 2.8 t ha^{-1}, much lower than the world average of 4.4 t ha^{-1}. Cold stress is one of the main contributing factors for the low productivity in rain fed lowland rice production.

Objective

to determine the variability between rice genotypes in phenological development and yield performance under cold stress.

Conclusions

- Early and medium duration genotypes gave higher yield with less unfilled grains.
- Minimum temperature coincided with flowering of long duration genotypes affecting yield.
- Short duration genotypes need to be adapted further to cope with climate change.

Results and Discussion

A PCA analyses clustered the 30 genotypes according to their phenological development and overall duration. Four groups were identified: early, medium, late and very late maturity (Table 1).

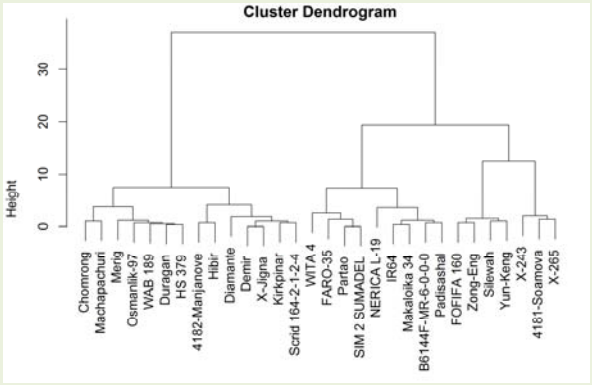


Figure 1. Distance of genotypes according to their maturity period

Early genotypes matured in 120 days, late genotypes matured in 180 days. Most of the tested genotypes matured bet-ween 140 and 160 days after sowing. The time from 50% emergence to maturity varied among genotypes.

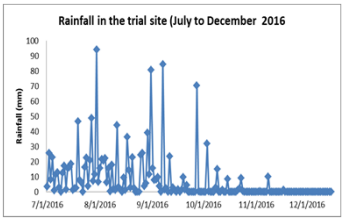
Early genotypes had a higher percentage of filled grains than the medium duration ones. Late and very late maturing suffered strongly from cold night spells shortly before flowering, resulting in high spikelet sterility and thus lower yield.

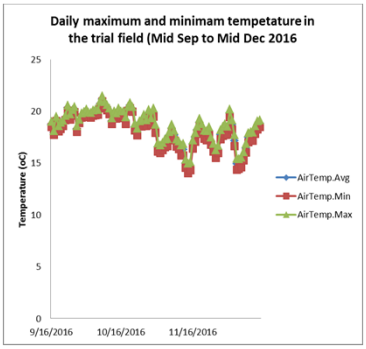
Table 1. Maturity and yield performance of thirty tested genotypes. Means with same letter are not significantly different at 95% CI.

Genotypes	Days to heading	Days to Maturity	Unfilled grain (%)	Yield (t/Ha)
Machapachuri	86 i	119 h	3.3 ef	5.5 ab
Chomrong	89 hi	120 h	0.5 f	6.5 a
Merig	90 hi	122 gh	8.6 def	5.2 abc
WAB 189	91hi	123 gh	3.4 ef	5.2 abc
Duragan	88 hi	123 gh	4.9 ef	5.1 abc
HS 379	88 hi	123 gh	6.3 def	4.7 abc
Osmanlik-97	90 hi	124 gh	3.9 ef	5.7 ab
X-Jigna	92 hi	127 gh	4.0 ef	5.2 abc
Demir	91 hi	127 gh	5.7 ef	5.7 ab
Scrid 164-2-1-2-4	100 fgh	128 gh	6.2 def	4.5 abc
Kirkpinar	91 hi	129 gh	7.3 def	4.9 abc
Diamante	97ghi	130 gh	6.9 def	5.7 ab
Hibir	96 ghi	132 g	5.2 ef	5.2 abc
4182-Manjanove	98 fghi	133 g	14.4 def	5.1 abc
X-265	106 efg	143 f	20.9 def	3.3 cde
4181-Soamova	108 efg	145 f	8.3 def	5.3 abc
X-243	109 ef	146 ef	18.0 def	3.8 bcd
FOFIFA 160	119 cde	156 de	27.2cd	3.1 cde
Zong-Eng	115 de	157 d	7.4 def	5.9 ab
Yun-Keng	114 de	157 cd	8.9 def	6.3 a
Silewah	122 bcd	158 bcd	7.3 def	3.7 bcd
NERICA L-19	117 cde	165 abcd	24.0 de	2.1 def
B6144F-MR-6-0-0-0	122 bcd	168 abc	92.6a	0.8 f
Padisashal	128 abc	168 ab	86.8 ab	0.4 f
Makaloika 34	129 abc	169 ab	70.9 b	1.2 ef
IR64	122 bcd	170 ab	44.6 c	1.7 def
WITA 4	134 ab	173 a	96.2a	0.3 f
FARO-35	131 ab	175 a	84.2 ab	1.3 ef
SIM 2 SUMADEL	138 a	176 a	95.8 a	0.2 f
Partao	133 ab	176 a	99.2 a	0.2 f
Prob.	***	***	***	***

Material and Methods

Thirty rice genotypes were tested in 2016/17 in a randomized complete block design with three replications in the Fogera plain. Soil is dominated by vertisol and clay texture. Rainy season is usually from June to September and the average annual rainfall is 1200mm. Average annual minimum and maximum temperature 13 oC and 25 oC, respectively. The weather data was recorded at 30 minutes interval throughout the cropping season .





This study is part of the project "Improving rice farmers' decision making in lowland rice-based systems in East Africa (East Africa 'RiceAdvice')", funded by the Federal Ministry of Economic Cooperation and Development (BMZ), Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH. Project number 14.1432.5-001.00, 81180340.