

High-throughput automation of stomata counting in a population of African rice (*Oryza glaberrima*) using transfer learning.

Sophie B. Cowling¹, Hamidreza Soltani², Sean Mayes¹, Erik H. Murchie¹

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Supplementary table 1: List of *O. glaberrima* accession codes, ecology, country and African region of origin. *O. glaberrima* germplasm was provided by Diversité Adaptation Developpement des plantes (DIADE), IRD-Montpellier, France. Information on accession ecology and country of origin was provided by AfricaRice.

Accession code	Ecology	Country of origin	African region
IRGC_96726	Irrigated lowland	Nigeria	West coast
TOG_5314	Irrigated lowland	Nigeria	West coast
TOG_5321	Rainfed lowland Shallow forest	Nigeria	West coast
TOG_5326	swamp	Nigeria	West coast
IRGC_96740	Irrigated lowland	Nigeria	West coast
TOG_5418	Lowland	Nigeria	West coast
TOG_5424	Rainfed lowland Shallow forest	Nigeria	West coast
TOG_5453	swamp	Nigeria	West coast
TOG_5486	Rainfed lowland	Nigeria	West coast
TOG_5494	Rainfed lowland	Nigeria	West coast
TOG_5500	Rainfed lowland	Nigeria	West coast
TOG_5556	Rainfed lowland	Nigeria	West coast
IRGC_86764	Irrigated lowland	Ghana	West coast
TOG_5666	Rainfed lowland	Nigeria	West coast
TOG_5672	Rainfed lowland	Nigeria	West coast
IRGC_96790	Irrigated lowland	Nigeria	West coast
TOG_5681	Rainfed lowland	Nigeria	West coast
TOG_5814	Rainfed lowland	Liberia	West coast
IRGC_56785	Irrigated lowland	Liberia	West coast
TOG_5882	Rainfed lowland	Nigeria	West coast
IRGC_112568	Irrigated lowland	Liberia	West coast
IRGC_86789	Irrigated lowland	Liberia	West coast
IRGC_86790	Irrigated lowland	Liberia	West coast
IRGC_86791	Irrigated lowland	Liberia	West coast
TOG_5953	Rainfed lowland	Nigeria	West coast
TOG_5969	Irrigated lowland	Nigeria	West coast

TOG_6205	Irrigated lowland	Guinea	West coast
TOG_6206	Irrigated lowland	Zimbabwe	South inland
TOG_6207	Irrigated lowland	Zimbabwe	South inland
TOG_6211	Irrigated lowland	Nigeria	West coast
TOG_6220	Irrigated lowland	Burkina Faso	West inland
TOG_6356	Rainfed lowland	Liberia	West coast
TOG_6603	Rainfed lowland	Liberia	West coast
TOG_6688	Rainfed lowland	Liberia	West coast
TOG_6698	Rainfed lowland	Liberia	West coast
TOG_6943	Irrigated lowland	Sierra Leone	West coast
TOG_6951	Irrigated lowland	Sierra Leone	West coast
TOG_7020	Irrigated lowland	Sierra Leone	West coast
TOG_7047	Irrigated lowland	Sierra Leone	West coast
TOG_7106	Irrigated lowland	Mali	West inland
TOG_7108	Irrigated lowland	Mali	West inland
TOG_5286	Rainfed lowland	Nigeria	West coast
TOG_5400	Lowland	Nigeria	West coast
TOG_5439	Rainfed lowland	Nigeria	West coast
LG33	Lowland	Mali	West inland
TOG_5464	Rainfed lowland	Nigeria	West coast
TOG_5533	Lowland	Nigeria	West coast
TOG_5566	Rainfed lowland	Nigeria	West coast
TOG_5591	Rainfed lowland	Ghana	West coast
TOG_5639	Rainfed lowland	Nigeria	West coast
CG10	Irrigated lowland	Senegal	West coast
TOG_7132	Irrigated lowland	Senegal	West coast
TOG_7134	Irrigated lowland	Senegal	West coast
TOG_5747	Rainfed lowland	Liberia	West coast
TOG_5775	Rainfed lowland	Liberia	West coast
TOG_5997	Upland	Nigeria	West coast
TOG_7420	Rainfed lowland	Sierra Leone	West coast
IRGC_103544	Irrigated lowland	Mali	West inland
RAM 131	Floating Rice	Mali	West inland

RAM 137	Floating Rice	Mali	West inland
RAM 24	Floating Rice	Guinea	West coast
RAM 48	Floating Rice	Mali	West inland
RAM 55	Floating Rice	Mali	West inland
RAM 77	Floating Rice	Mali	West inland
CG14	Irrigated lowland	Senegal	West coast
IG38	Rainfed lowland	Côte d'Ivoire	West coast
TOG_14367	Irrigated lowland	Guinea	West coast
YG353	Rainfed lowland	Guinea	West coast
MG04	Lowland	Mali	West inland
TOG_7214	Irrigated lowland	Upland	West inland
CG171	Irrigated lowland	Senegal	West coast
TOG_7219	Irrigated lowland	Mali	West inland
IRGC_103549	Irrigated lowland	Mali	West inland
TOG_10434	Irrigated lowland	Côte d'Ivoire	West coast
TOG_7255	Irrigated lowland	Chad	North inland
TOG_12086	Rainfed lowland	Nigeria	West coast
TOG_12160	Rainfed lowland	Nigeria	West coast
TOG_12188	Rainfed lowland	Nigeria	West coast
TOG_12249	Rainfed lowland	Nigeria	West coast
TOG_7273	Irrigated lowland	Cameroon	West coast
	Shallow Forest		
TOG_7274	Swamp	Cameroon	West coast
IRGC_104589	Irrigated lowland	Burkina Faso	West inland
IRGC_86826	Irrigated lowland	Ghana	West coast
TOG_7406	Rainfed lowland	Ghana	West coast
TOG_7451	Irrigated lowland	Burkina Faso	West inland
TOG_7455	Irrigated lowland	Burkina Faso	West inland
TOG_7456	Irrigated lowland	Burkina Faso	West inland
TOG_7455	Irrigated lowland	Côte d'Ivoire	West coast
TOG_7993	Irrigated lowland	Nigeria	West coast
TOG_8049	Irrigated lowland	Nigeria	West coast
TOG_8527	Irrigated lowland	Gambia	West coast

TOG_8537	Irrigated lowland	Gambia	West coast
TOG_8545	Irrigated lowland	Gambia	West coast
TOG_9524	Irrigated lowland	Côte d'Ivoire	West coast
TOG_12358	Upland	Côte d'Ivoire	West coast
TOG_12366	Rainfed lowland	Guinea-Bissau	West coast
TOG_12372	Rainfed lowland	Guinea-Bissau	West coast
TOG_12387	Rainfed lowland	Tanzania	East coast
TOG_12388	Rainfed lowland	Cameroon	West coast
TOG_12399	Upland	Guinea	West coast
TOG_12401	Upland	Guinea	West coast
TOG_12411	Upland	Guinea	West coast
TOG_12414	Upland	Guinea	West coast
YG330	Rainfed lowland	Guinea	West coast
TOG_13645	Irrigated lowland	Guinea	West coast
TOG_13708	Irrigated lowland	Guinea	West coast
TOG_14093	Irrigated lowland	Guinea	West coast
TOG_14116	Rainfed lowland	Liberia	West coast
TOG_14184	Rainfed lowland	Zimbabwe	South inland
YG482	Rainfed lowland	Guinea	West coast
TOG_14361	Rainfed lowland	Guinea	West coast
TOG_14373	Irrigated lowland	Guinea	West coast
TOG_14606	Irrigated lowland	Guinea	West coast
TOG_14610	Irrigated lowland	Guinea	West coast
TOG_7190	Irrigated lowland	Côte d'Ivoire	West coast
IG05	Rainfed lowland	Côte d'Ivoire	West coast
IG09	Rainfed lowland	Côte d'Ivoire	West coast
IG14	Rainfed lowland	Côte d'Ivoire	West coast
IG15	Rainfed lowland	Côte d'Ivoire	West coast
IG16	Rainfed lowland	Côte d'Ivoire	West coast
IG19	Rainfed lowland	Côte d'Ivoire	West coast
IG21	Rainfed lowland	Côte d'Ivoire	West coast
IG23	Rainfed lowland	Côte d'Ivoire	West coast
IG35	Rainfed lowland	Côte d'Ivoire	West coast

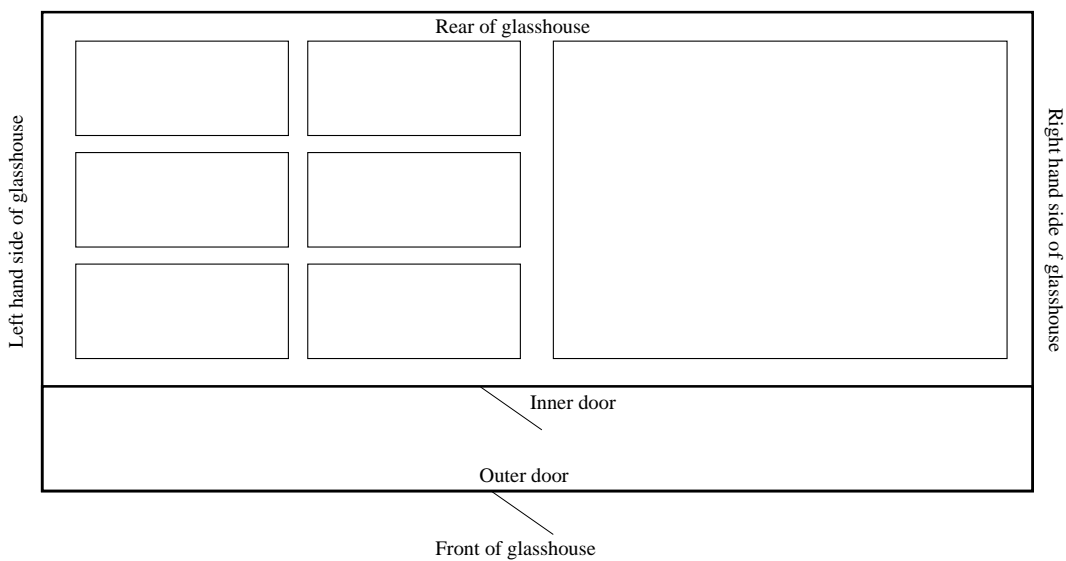
IG36	Upland	Côte d'Ivoire	West coast
IG43	Rainfed lowland	Côte d'Ivoire	West coast
IG47	Rainfed lowland	Côte d'Ivoire	West coast
IG324	Rainfed lowland	Côte d'Ivoire	West coast
EG55	Lowland	Tanzania	East coast
EG85	Lowland	Tanzania	East coast
UG14	Lowland	Cameroon	West coast
UG20	Lowland	Cameroon	West coast
UG26	Lowland	Cameroon	West coast
UG28	Rainfed lowland	Cameroon	West coast
UG30	Rainfed lowland	Cameroon	West coast
LG07_S	Lowland	Mali	West inland
LG64	Lowland	Mali	West inland
MG53	Lowland	Mali	West inland
1MG54	Lowland	Mali	West inland
TG10	Irrigated lowland	Chad	North inland
TG19_G	Irrigated lowland	Chad	North inland
TG25	Irrigated lowland	Chad	North inland
TG57	Irrigated lowland	Chad	North inland
CG45	Irrigated lowland	Senegal	West coast
CG46	Irrigated lowland	Senegal	West coast
CG70	Irrigated lowland	Senegal	West coast
CG150	Irrigated lowland	Senegal	West coast
CG156	Irrigated lowland	Senegal	West coast
CG164	Irrigated lowland	Senegal	West coast
CG170	Irrigated lowland	Senegal	West coast
OG1	lowland	Senegal	West coast
OG3	lowland	Senegal	West coast
OG15	lowland	Senegal	West coast
YG307	Upland	Guinea	West coast
YG316	Rainfed lowland	Guinea	West coast

Supplementary Table 2: Table detailing sowing and measurement dates of one hundred and fifty-five *O. glaberrima* accessions. This table details how the *O. glaberrima* accessions were grouped into batches of twelve, each accession name was assigned a Nottingham line number for ease. The sowing date, date of the week that measurements commenced and date of the week that measurements ceased for each batch of accessions.

<i>O. glaberrima</i> line no.	Sowing date	Measurement start date	Measurement end date
1 - 12	26/04/2017	12/06/2017	16/06/2017
13-24	08/05/2017	26/06/2017	30/06/2017
25-36	22/05/2017	10/07/2017	14/07/2017
37-48	05/06/2017	24/07/2017	28/07/2017
49-60	19/06/2017	07/08/2017	11/08/2017
61-72	03/07/2017	21/08/2017	25/08/2017
73-84	17/07/2017	04/09/2017	08/09/2017
121-132	24/07/2017	11/09/2017	14/09/2017
85-69	31/07/2017	18/09/2017	22/09/2017
133-144	07/08/2017	25/09/2017	28/09/2017
97-108	14/08/2014	02/10/2017	06/10/2017
145-156	21/08/2017	09/10/2017	12/10/2017
109-120	28/08/2017	16/10/2017	20/10/2017

Supplementary Figure 1: *O. glaberrima* phenotyping experimental plan. (a) The left-hand side of the agronomy style glass house was divided into six small beds, three of these were used for the first six batches of measurements, following these all six beds were used until all accessions had been measured. (b) In each small bed twelve accessions and IR64, with five replicates, were grown. The accessions were surrounded by a border of spare seedlings, to minimise for edge effects. Accessions were not randomised to minimise plant damage and mismeasurement during LiCor analysis. Through this process, (c) a batch rotation through the available beds facilitated the growth and analysis of all accessions.

(a)



(b)

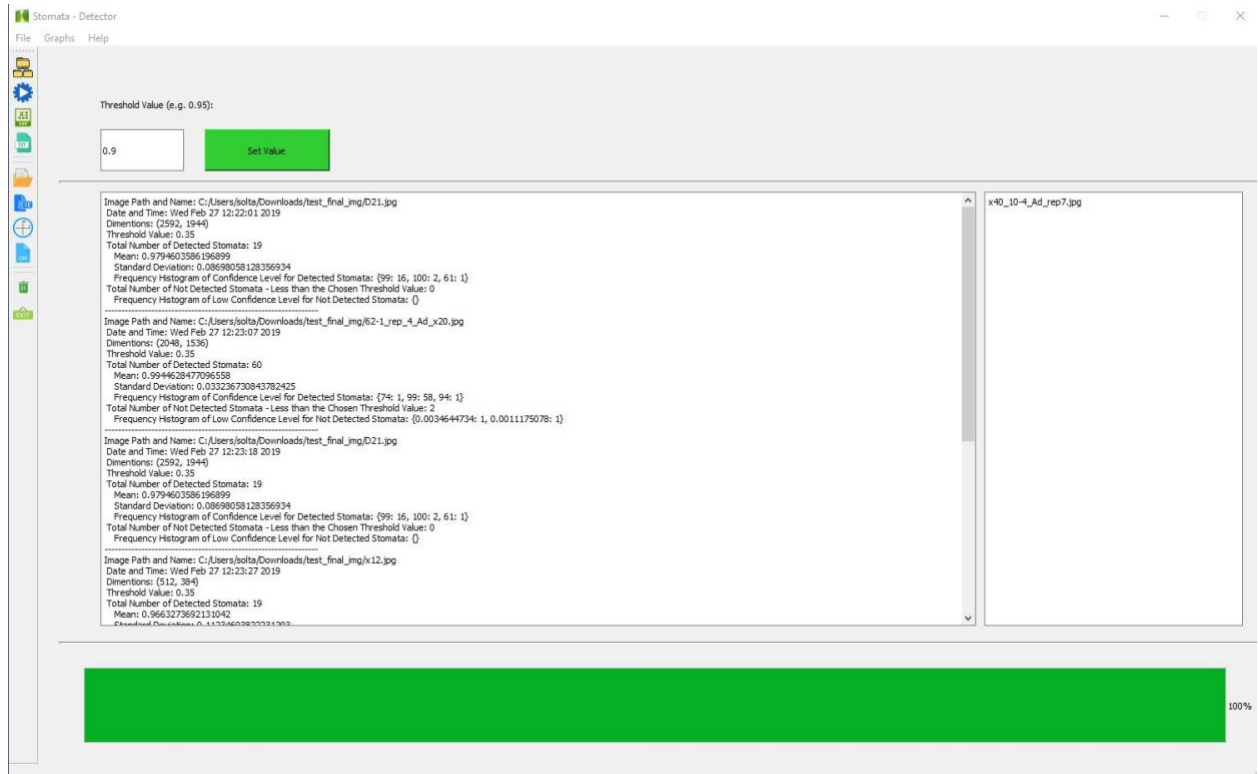
Border	Border	Border	Border	Border	Border	Border	Border	Border	Border	Border	Border
Border			Line 1			IR64			Line 7		Border
Border			Line 2						Line 8		Border
Border			Line 3						Line 9		Border
Border			Line 4						Line 10		Border
Border			Line 5						Line 11		Border
Border			Line 6						Line 12		Border
Border	Border	Border	Border	Border	Border	Border	Border	Border	Border	Border	Border
Border	Border	Border	Border	Border	Border	Border	Border	Border	Border	Border	Border
Border			Line 13			IR64			Line 19		Border
Border			Line 14						Line 20		Border
Border			Line 15						Line 21		Border
Border			Line 16						Line 22		Border
Border			Line 17						Line 23		Border
Border			Line 18						Line 24		Border
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Border			Line 25			IR64			Line 31		Border
Border			Line 26						Line 32		Border
Border			Line 27						Line 33		Border
Border			Line 28						Line 34		Border
Border			Line 29						Line 35		Border
Border			Line 30						Line 36		Border
Border	Border	Border	Border	Border	Border	Border	Border	Border	Border	Border	Border
Border	Border	Border	Border	Border	Border	Border	Border	Border	Border	Border	Border

(c)



Supplementary Figure 2: Images of Stomata Detector software. Screenshots taken of the Stomata Detector software, showing (a) the graphical user interface, where files and folders are loaded and executed; (b) the back end, which gives a summary of which micrographs are running and the outputs; (c) image outputs from a single micrograph analysis, showing the objects identified as stomata in green bounding boxes, the total number of stomata identified and the micrograph file pathway.

(a)



(b)

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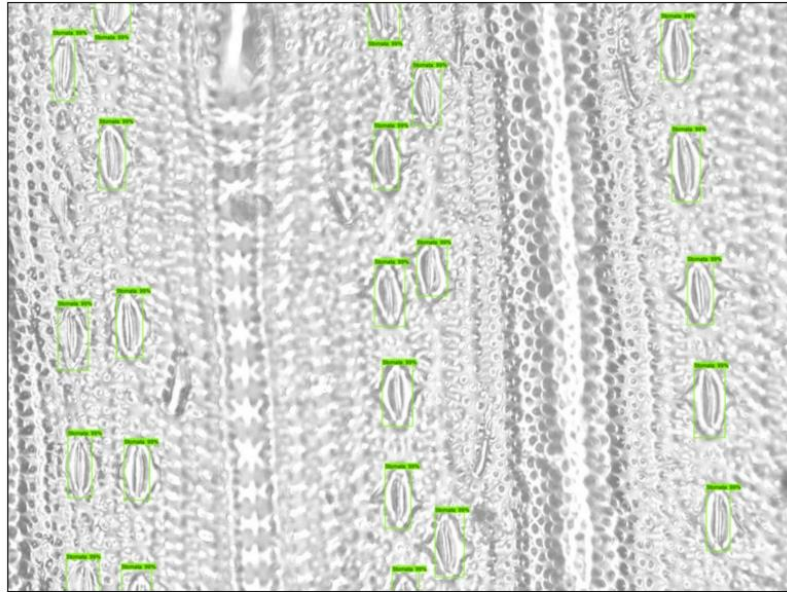
Stomata-Detector
[38816] LOADER: callfunction returned...
[38816] LOADER: Installing PYZ archive with Python modules.
[38816] LOADER: PYZ archive: out00-PYZ.pyz
[38816] LOADER: Running pyiboot01_bootstrap.py
[38816] LOADER: Running pyi_rth_pkgres.py
[38816] LOADER: Running pyi_rth_win32comgenpy.py
[38816] LOADER: Running pyi_rth_qt5.py
[38816] LOADER: Running pyi_rth_multiprocessing.py
[38816] LOADER: Running pyi_rth_tkinter.py
[38816] LOADER: Running pyi_rth_mplconfig.py
[38816] LOADER: Running pyi_rth_mpldata.py
[38816] LOADER: Running main.py
QWindowsNativeFileDialogBase::onSelectionChange () 0
QWindowsNativeFileDialogBase::onSelectionChange () 0
QWindowsNativeFileDialogBase::onSelectionChange (QUrl("file:///C:/Users/stxsbc/Desktop/Randoms")
) 1
QWindowsNativeFileDialogBase::onSelectionChange () 0
QWindowsNativeFileDialogBase::onSelectionChange () 0
QWindowsNativeFileDialogBase::onSelectionChange (QUrl("file:///C:/Users/stxsbc/Desktop/Randoms/
x40_10-4_Ad_rep7.jpg")) 1
C:\Program Files (x86)\Stomata-Detector\utils\visualization_utils.py:17: UserWarning: matplotlib
p.pyplot as already been imported, this call will have no effect.
  import matplotlib; matplotlib.use('Agg') # pylint: disable-multiple-statements
2021-10-16 17:42:55.360711: I tensorflow/core/platform/cpu_feature_guard.cc:141] Your CPU suppo
rts instructions that this TensorFlow binary was not compiled to use: AVX2

Image Path and Name: C:/Users/stxsbc/Desktop/Randoms/x40_10-4_Ad_rep7.jpg
Image Dimentions: (1728, 1296)
Threshold Value: 0.9 --> 90 %
Total Number of Detected Stomata:** 22 **
Number of Not Detected Stomata (Low Confidence Level): 3

```

(c)

Total number of detected Stomata: 23

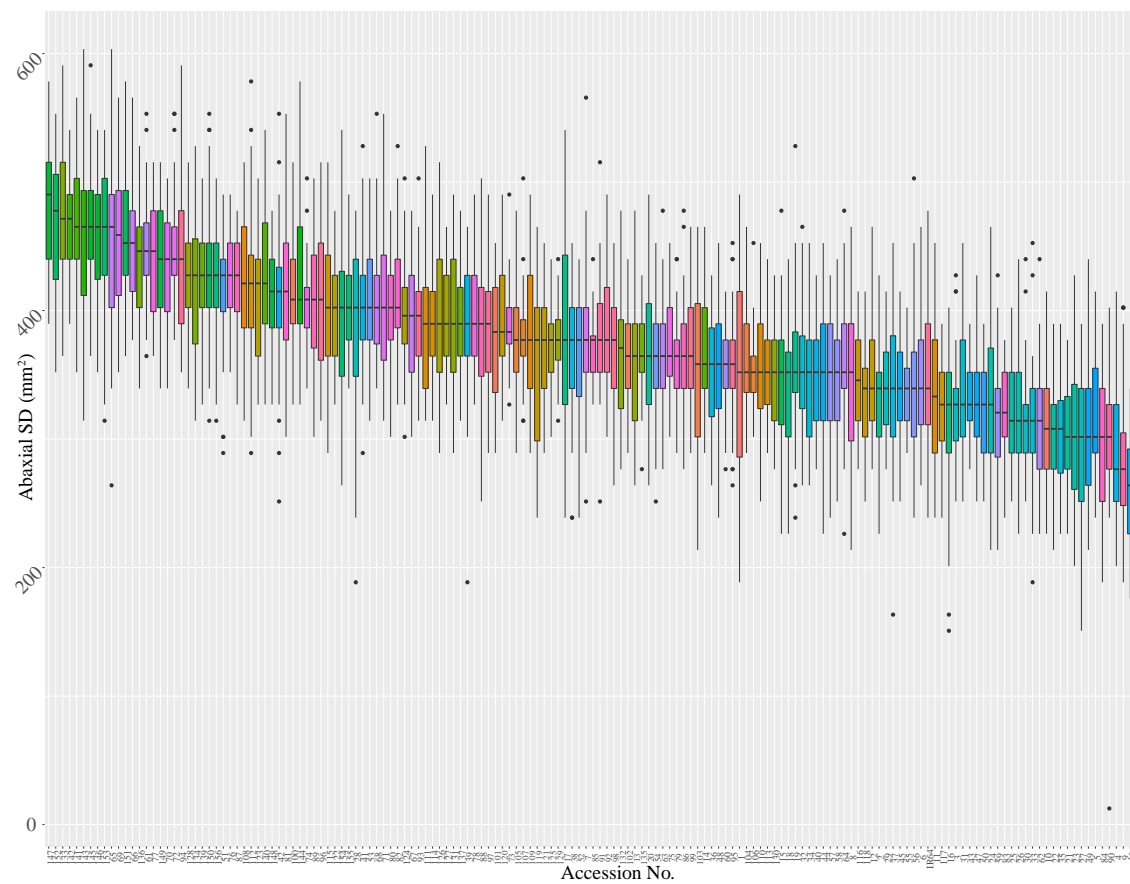


Stomata Path and Name: C:/Users/stxsbc/Desktop/Randoms/x40_11-4_Ad_rep6.jpg
Threshold value: 0.9

Supplementary Figure 3: Boxplot of stomatal density for the *O. glaberrima* population.

The boxplots show stomatal density calculated from the automated stomata counts generated by Stomata Detector, showing (a) abaxial and (b) adaxial stomatal density for the 155 *O. glaberrima* accessions and *O. sativa* cultivar, IR64

(a)



(b)

