ANALYSIS OF ROSETTE DISEASE RESISTANCE IN ADVANCED GROUNDNUT LINES IN NORTHERN MOZAMBIQUE

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INTRODUCTION & AIM

Groundnut (*Arachis hypogaea* L.) is a major oilseed and protein crop in tropical regions and the third most important food crop in Mozambique. Despite its importance, national production remains low, averaging only ~300 kg ha^{-1}, far below the potential 3,000–4,000 kg ha^{-1} attainable under optimal conditions. Most farmers rely on low-input systems and local landraces, which limits yield and increases vulnerability to biotic stresses, particularly Groundnut Rosette Disease (GRD).

GRD is endemic in the northern region—Mozambique's main production zone—and can cause yield losses of up to 100%. Its incidence is influenced by aphid pressure, climatic variability, and environmental conditions, especially prolonged drought. Symptoms include chlorotic, green, and mosaic rosette forms. Resistant cultivars remain scarce, and susceptibility has hindered adoption of improved high-yielding varieties released by the national research program (IIAM).

To address the limited genetic variability for GRD resistance, IIAM introduced Spanish × Virginia breeding lines from ICRISAT–Malawi and tested them in multi-environment trials (METs). METs are essential for understanding environmental effects, G×E interaction, and genotype adaptability in disease-prone regions. Analytical approaches such as AMMI and GGE biplots help identify stable and well-adapted lines.

This study evaluates the effects of genotype, environment, and G×E interaction on GRD incidence and grain yield across 11 environments in northern Mozambique.

METHOD

Experimental sites:

Trials were conducted in three IIAM research stations in northern Mozambique: Nampula, Namapa, and Mapupulo, across four consecutive seasons (2014-2018), with the final season conducted only in Nampula and Namapa, resulting in a total of 11 environments (figure1).
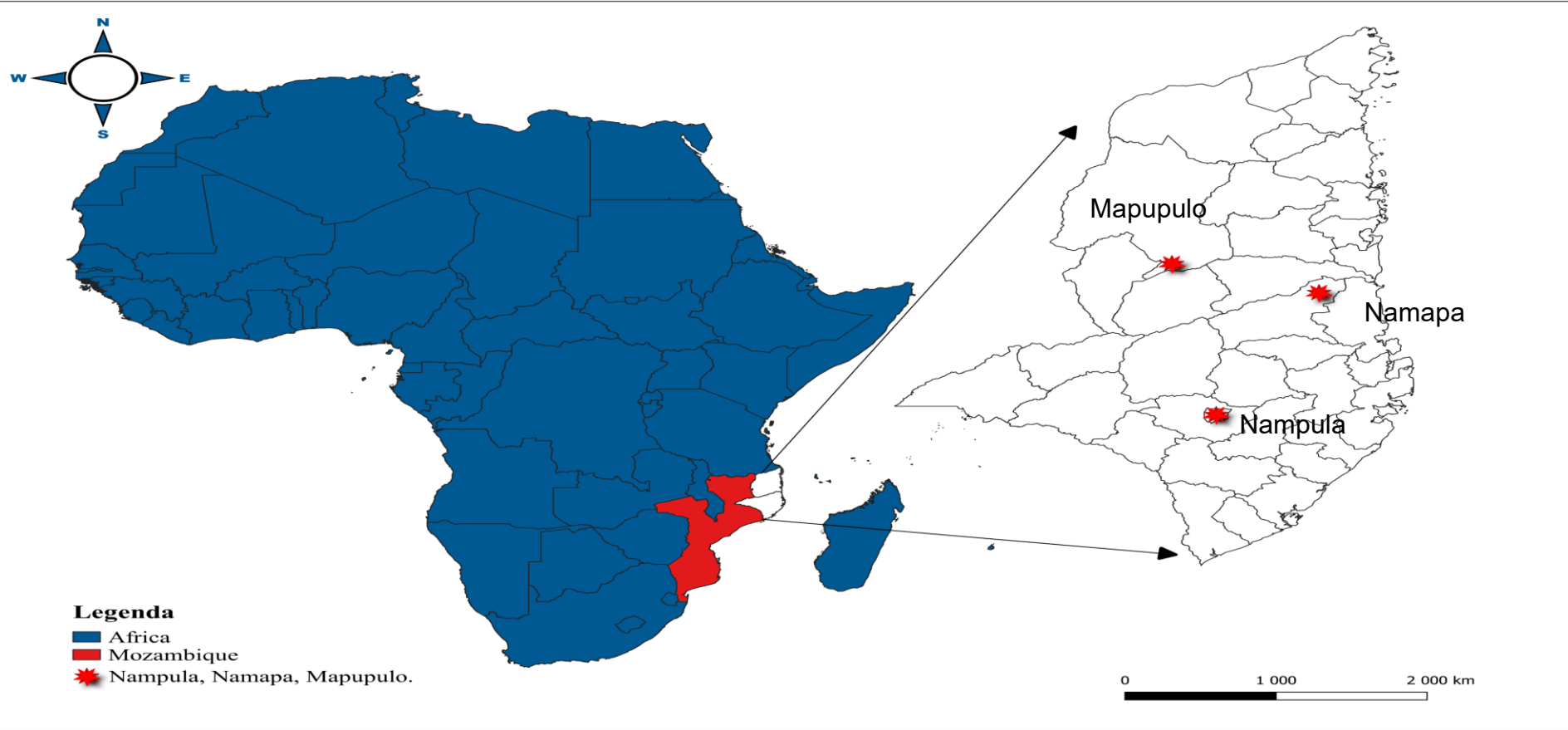

Figure 1. experimental sites

Twenty genotypes (18 Spanish × Virginia lines from ICRISAT, plus JL-24 as a susceptible check and one local variety) were evaluated. Experiments used an alpha-lattice design with two replications. Plots consisted of two 5-m rows spaced at 50 × 10 cm.

RESULTS & DISCUSSION

Table 1. Percentage of the variances of all evaluated traits. GRVI – Groundnut rosette disease incidence; PY-Pod yield; Gr – Grain percent; GY – Grain Yield; IPS – Initial plants stand; FPS – Final plants stand; PN_M2 – pods per square meter; SW_100 – 100 seed weight; DE- Days to emergency; DF – Days to flowering; Mat – maturity percentage; [1]- analysis conducted in a fewer environments. Ns- not significant; *- Significant (p<0,05); **- Highly significant (p<0.01) and *** – Very highly significant (p<0.001) according to the DGC test

FV	GRVI	PY	Gr	GY	IPS	FPS	PN_M2	SW_100	DE	DF	DH	Mat[1]
Environment	92.9	74.2	79.5	71.1	86.5	92.8	74.2	19.3	35.1	79.9	76.2	100
Genotype	1.1	4.8	0.9	3.5	6.4	0.6	4.8	4.2	9.4	4.7	5.7	0
GxE	6.0	20.9	19.6	25.4	7.1	6.6	20.9	76.5	55.4	15.4	15.4	0
Significance												
Environment	***	***	***	***	***	***	***	***	***	***	***	***
Genotype	**	***	**	***	*	*	***	***	***	***	***	Ns
GxE	**	***	***	***	***	***	***	***	***	***	***	Ns

Groundnut Rosette Disease (GRD) Incidence

Rosette incidence in the 20 genotypes was strongly influenced by the environment, which explained 92.9% of the variance (Table 1), resulting in a G×E interaction six times larger than genotype effects. The susceptible check JL-24 confirmed disease presence, showing large variation across environments. NPL_15 showed the highest incidence (mean 21%; JL-24 = 56%), allowing clear phenotypic differentiation among genotypes (Figure 2). Based on Subrahmanyam et al. (2002) and Ntare & Olorunju (2001), in NPL_15 one genotype was highly resistant (ICGV-SM 8530) and six were moderately resistant (ICGV-SM 7508, 7518, 7533, 7558, 7566, and ICG 405). The GGE biplot analysis grouped all Nampula environments (NPL_14, 15, 16, 18) in the same mega-environment, confirming Nampula as a reliable selection site for GRD resistance (Figure 1).

GRD incidence did not correlate with grain yield, consistent with Kankam et al. (2020), who also found no yield reduction for disease incidence <15%.
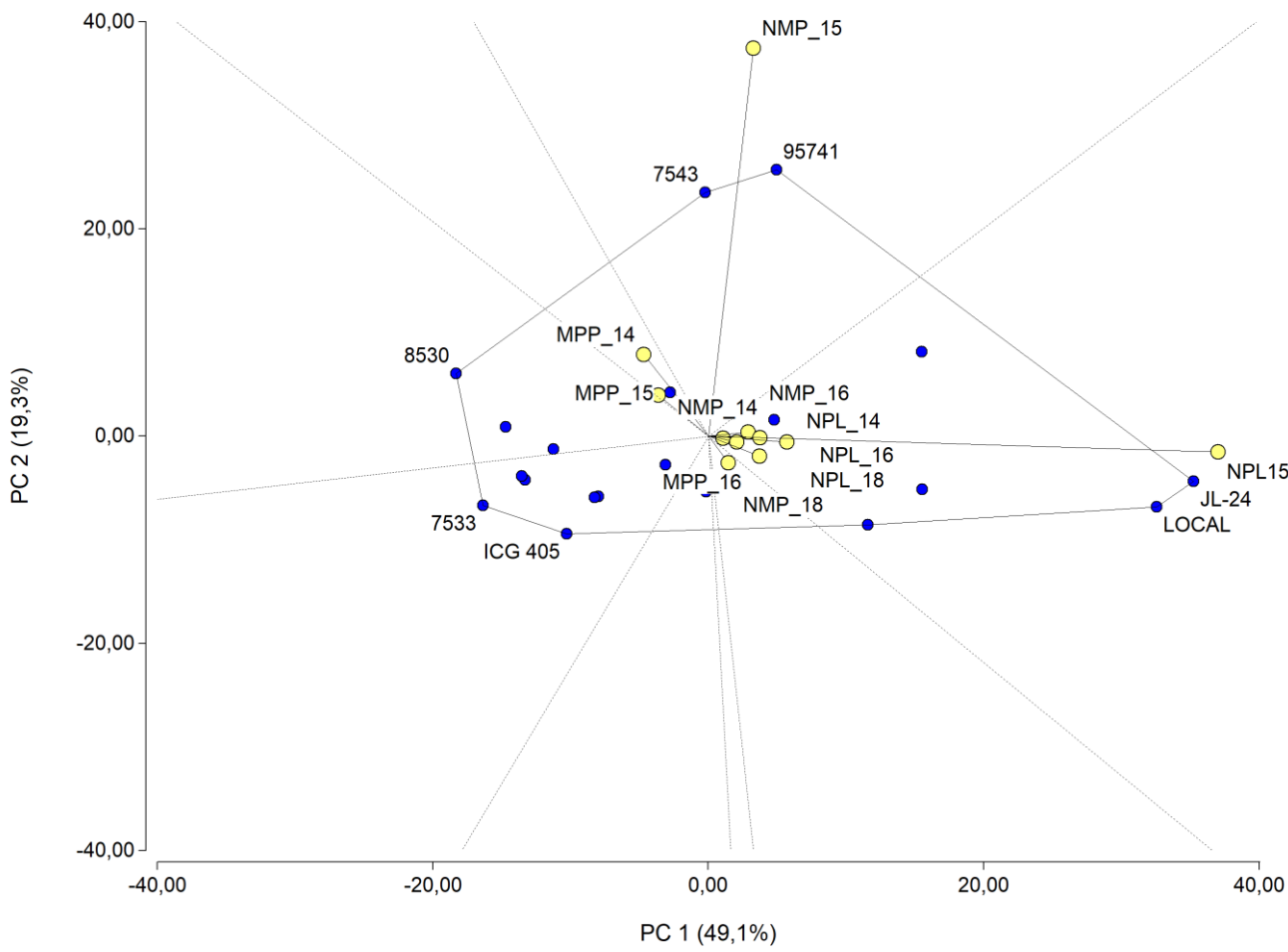

Figure 2. GGE Biplot for GRD Incidence. Blue points represent the genotypes and yellow points the environments

Grain Yield of Genotypes

Average grain yield across environments was 681 kg ha^{-1}, above the regional average of 300 kg ha^{-1}. G×E interaction accounted for 25.4% of total variation (Table 1), mainly driven by year effects, as shown by GGE biplot separation of years within locations (Figure 4). AMMI1 identified ICGV-SM 7518, 7510, 7533, and 95741 as the highest-yielding and most stable genotypes (Figure 3). Yield variability was associated with IPS, FPS, PN_M2, PY, SW_100, and Gr, with IPS and FPS being key drivers. IPS averaged 68% and FPS 55% of expected plant density, reflecting low-input farmer conditions and moisture variability.

Under these conditions, ICGV-SM 7510 stands out due to high and stable IPS, stable yield, and moderate GRD resistance. The disease-resistant genotype ICGV-SM 8530 also combined high IPS stability with superior yield in the GRD-prone mega-environment.
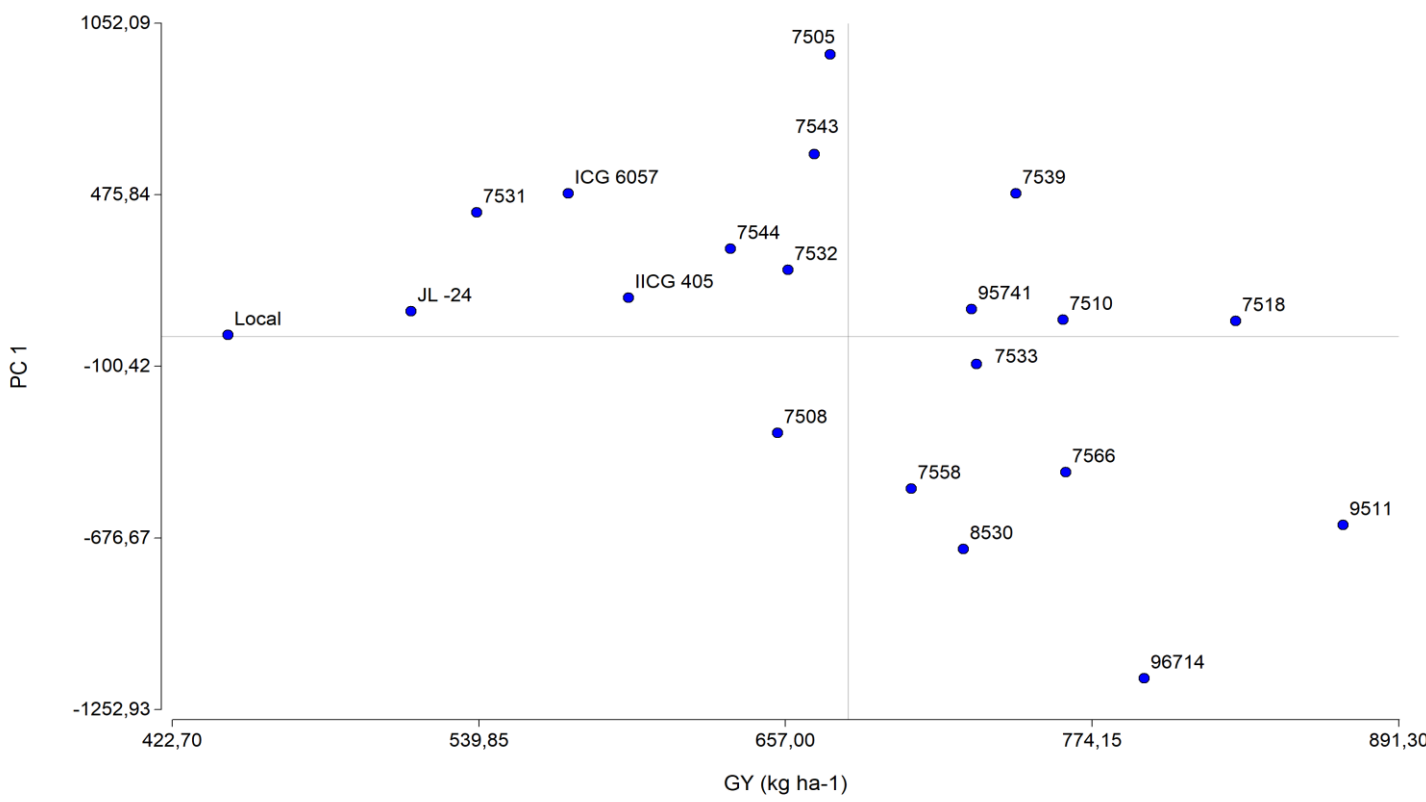

Figure 3. AMMI1 biplot for grain yield. Blue points represent the genotypes
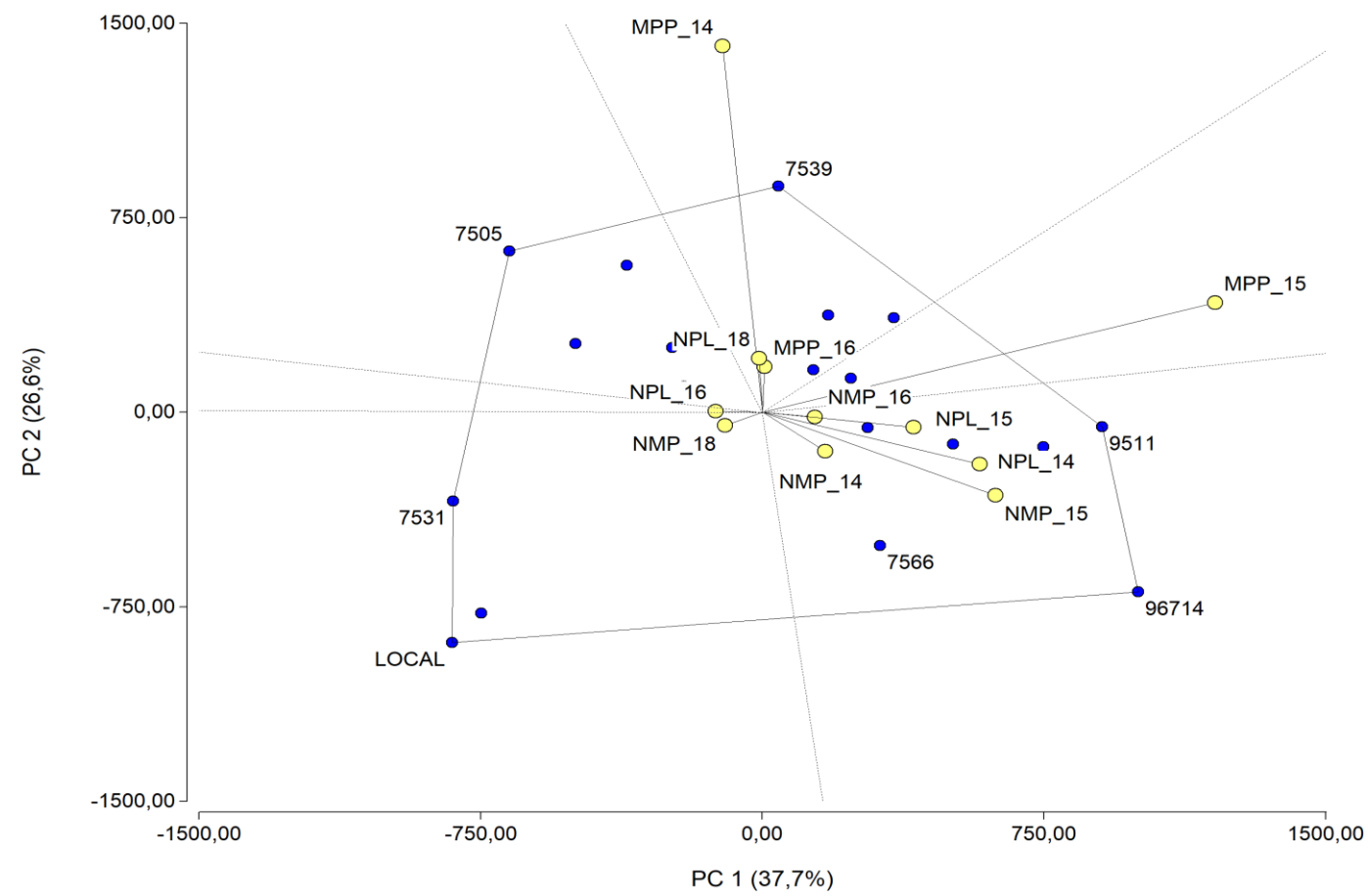

Figure 4. GGE biplot for grain yield. Blue points represent the genotypes, and yellow points represent the environments

CONCLUSION

The study revealed strong environmental influence and G×E interaction for both GRD incidence and grain yield. Nampula proved to be the most reliable selection site for GRD. Genotype ICGV-SM 8530 showed high resistance. The genotypes ICGV-SM 7510 and ICGV-SM 7518 are broadly adapted, high-yielding genotypes. Notably, the resistant genotype ICGV-SM 8530 also achieved stable yield in environments with the highest disease pressure.

FUTURE WORK / REFERENCES

Subrahmanyam, P., Merwe, P. J. A. Vander, Chiyembekeza, A. J., & Chandra, S. (2002). Integrated Management Of Groundnut Rosette Disease. African Crop Science Society. *African Crop Science Journal*, 10(1), 99–110.

Ntare, B. R., & Olorunju, P. E. (2001). Variation in yield and resistance to groundnut rosette disease in early- and medium-maturing groundnut genotypes in Nigeria. *African Crop Science Journal*, 9(2). https://doi.org/10.4314/acsj.v9i2.27617