Effect of domestication on the genotypic and phenotypic diversity of *Allanblackia parviflora* in Ghana

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Introduction

Allanblackia parviflora A. Chev. is an indigenous tree species which is found in West African rainforest zones. It is an underutilized fruit tree species that has been targeted for improvement as part of efforts to domesticate high-value indigenous multi-purpose trees for fruit and seed production in Africa. *Allanblackia* has several benefits, such as providing shade, timber, and medicine; however, the production of edible oil from its seeds is the economically most important use. There is evidence that the *Allanblackia* seed oil, which is used for cooking, the production of margarine and the manufacturing of ointments and soap, is being developed as a new agri-business in Ghana, Nigeria, Cameroon, and Tanzania. Despite the nutritional and socio-economic importance of *A. parviflora*, it is still at the early stages of its domestication process. There is still limited scientific information available on its morphological and genetic diversity and silvicultural management in West Africa. The objective of this study was to assess morphological and genetic diversity of wild and domesticated populations of *A. parviflora across ecological zones* in Ghana.

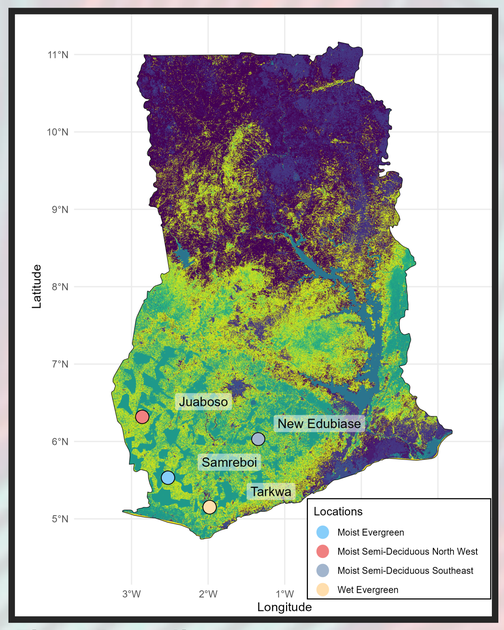
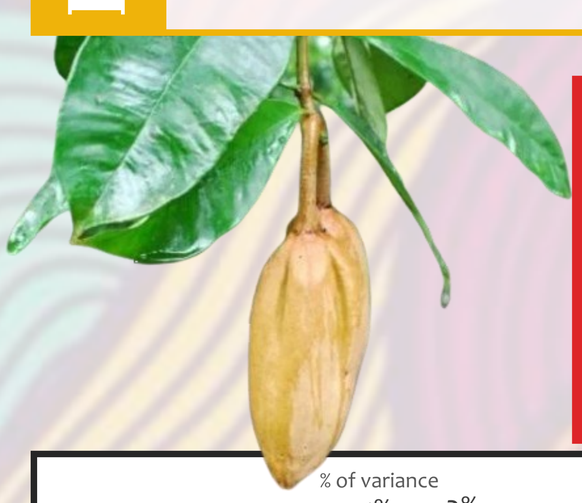


Fig 1. Sampling area



Methods

The data and samples were collected across four ecological zones in Ghana (Fig. 1), namely the Moist Semi-Deciduous North West (*MSNW*) zone, the Moist Evergreen (ME) zone, the Wet Evergreen (WE) zone and the Moist Semi-Deciduous Southeast (MSSE) zone, and in each zone we sampled trees from farms (cultivated) and from forest (wild). In total, seven fruit traits and six tree traits were used for evaluating morphological diversity, and 1091 SNP markers were developed by the DArT seq platform to assess the genetic diversity of the selected individuals.

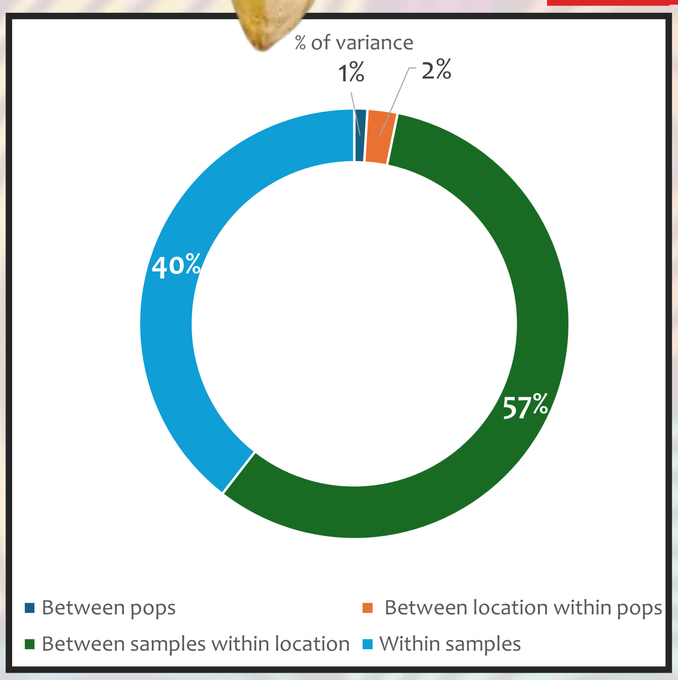


Fig 3. Analysis of molecular variance

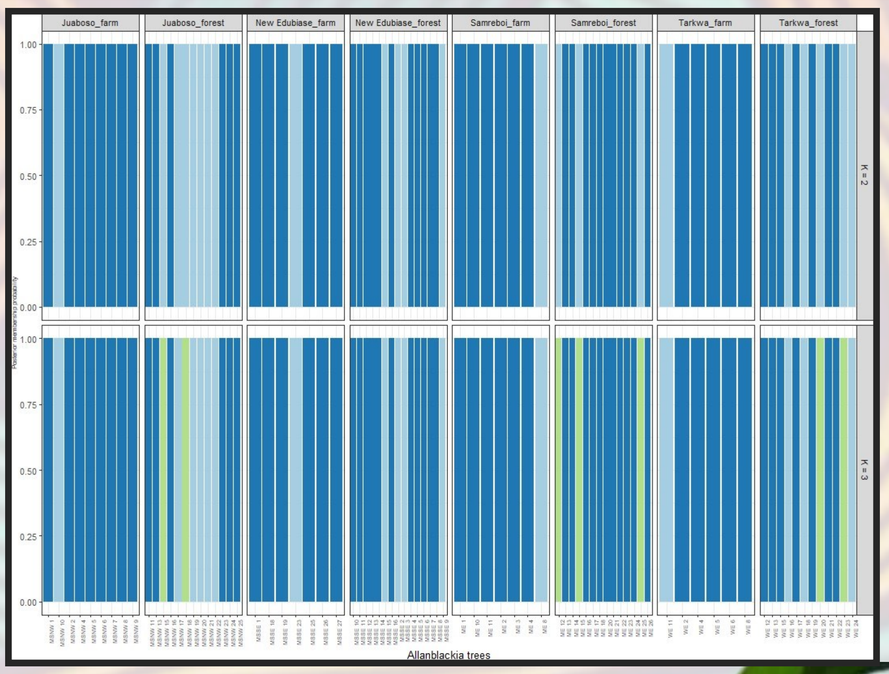


Fig 4. Discriminant analysis of principal components

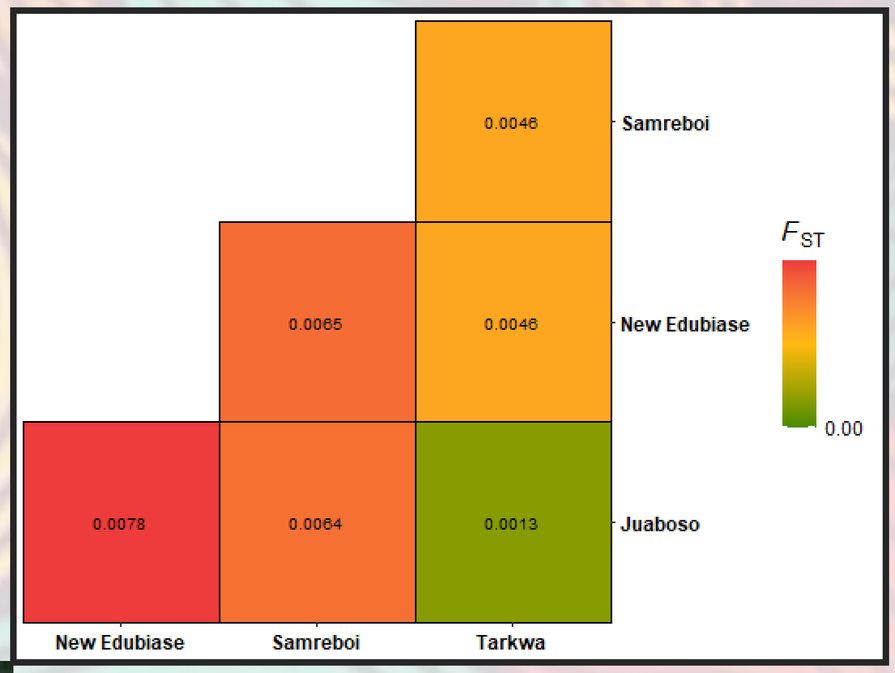
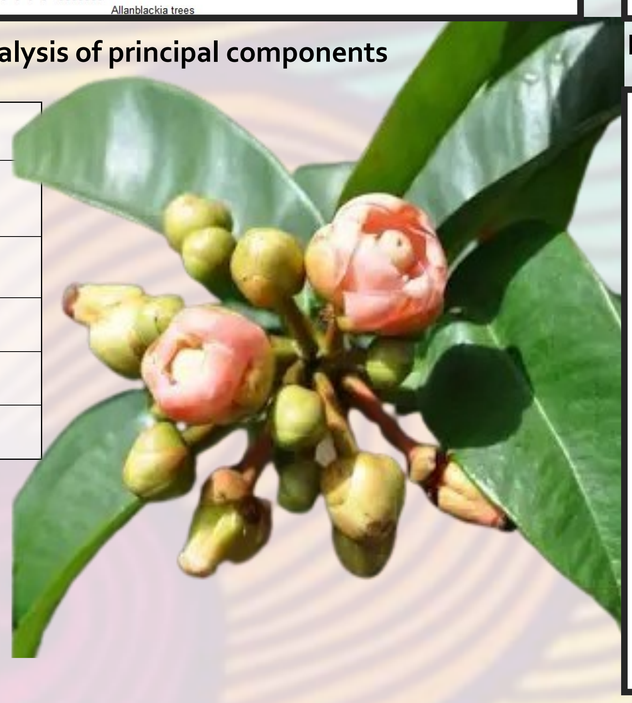


Fig 2. Pairwise Fst for populations of *A. parviflora*

pop	N	H	Hexp	Hobs	Fis
Juaboso	22	3.09	0.082	0.029	0.484
New Edubiase	22	3.09	0.068	0.030	0.399
Samreboi	21	3.04	0.089	0.044	0.360
Tarkwa	18	2.89	0.090	0.031	0.477
Total	83	4.42	0.084	0.034	

Tab 1. Genetic diversity indices of populations of *A.parviflora*
N: number of individuals, H: Shannon index, Hexp: expected heterozygosity, Hobs: observed heterozygosity, Fis: Inbreeding coefficient



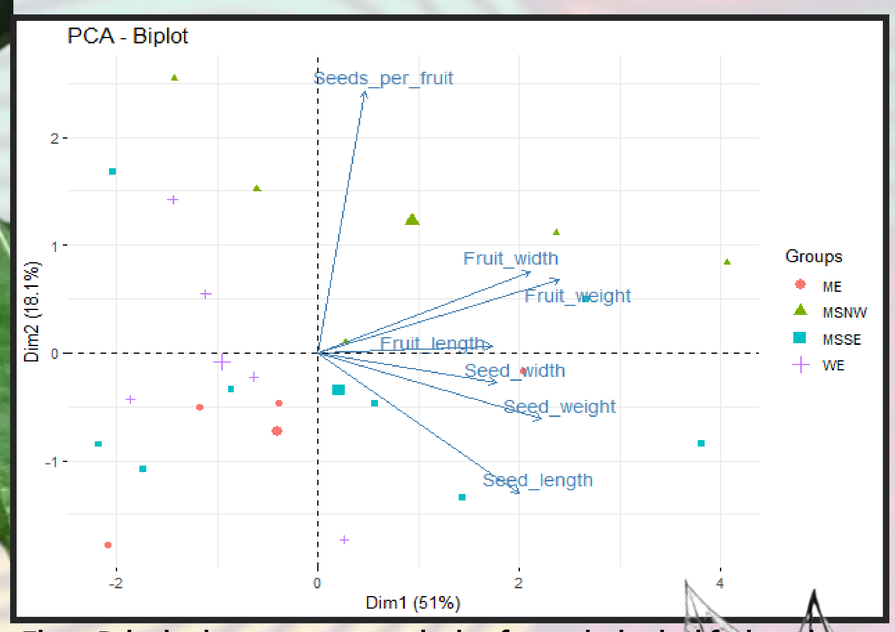


Fig 5. Principal component analysis of morphological fruit traits

		Fruit			Seed			
pop	ecology	weight (g)	length (cm)	width (cm)	weight (g)	length (cm)	width (cm)	nr. per fruit
Juaboso	MSNW	1249.8 [a]	25.67	10.00	7.68	3.13	2.21	24.67 [a]
New Edubiase	ME	820.75 [b]	21.17	8.73	7.29	3.28	2.28	13.62 [b]
Samreboi	MSSE	979.85 [b]	23.66	9.70	6.98	3.42	2.17	14.82 [b]
Tarkwa	WE	745.47 [b]	19.27	9.27	9.94	3.20	1.98	16.76 [b]

Tab 2. Morphological fruit traits of populations of *A. parviflora*. Different letter within column means significant difference at p=0.05

Results

The basic genetic diversity indices showed a rather low genetic diversity (observed heterozygosity ranged from 0.029 to 0.044, Tab. 1) and low differentiation between populations (pairwise Fst between ecological zones ranged from 0.0013 to 0.0078, Fig. 2), however the results from AMOVA (Fig. 3) showed significant variation between cultivated and wild individuals within each ecological zone, which is also visible in DAPC (Fig. 4). ANOVA of the morphological traits showed significant differences of some fruit traits (number of seeds per fruit and fruit weight) between ecological zones (Tab. 2), which is confirmed by PCA (Fig. 5). The results imply that both ecological zones and farmers' selection have an influence on shaping the genetic and phenotypical diversity of *A. parviflora* in Ghana.