

Table S1. Two provitamin A maize synthetics, their selection cycles, varietal-cross hybrids and a check variety included in the present study.

S/N	Pedigree
<u>Parental synthetics</u>	
1	PVASYNHGAC0
2	PVASYNHGAC1
3	PVASYNHGAC2
4	PVASYNHGBC0
5	PVASYNHGBC1
6	PVASYNHGBC2
<u>Varietal crosses</u>	
7	PVASYN HGBC0/PVASYN HGAC0
8	PVASYN HGBC1/PVASYN HGAC0
9	PVASYN HGBC2/PVASYN HGAC0
10	PVASYN HGBC0/PVASYN HGAC1
11	PVASYN HGBC1/PVASYN HGAC1
12	PVASYN HGBC2/PVASYN HGAC1
13	PVASYN HGBC0/PVASYN HGAC2
14	PVASYN HGBC1/PVASYN HGAC2
15	PVASYN HGBC2/PVASYN HGAC2
16	PVASYN13 (Check)

Table S2. *crtRB1* Kompetitive Allele Specific PCR (KASP) assays used to improve provitamin A carotenoids in two maize synthetics (HGA and HGB) evaluated across eight environment in Nigeria.

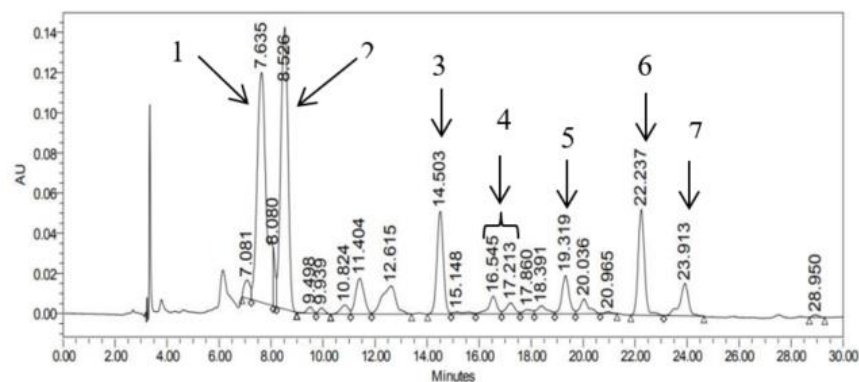
S/N	SNP ID	Source	Intertek ID	Favourable Allele	Unfavourable Allele
1	S10_134583972	CIMMYT	SnpZM0013	GG	CC
2	S10_134655704	CIMMYT	SnpZM0014	CC	TT
3	SYN11355	CIMMYT	SnpZM0015	AA	GG
4	PZE-110083653	CIMMYT	snpZM0016	GG	AA
5	S10_136072513	CIMMYT	SnpZM0017	TT	GG
6	S10_136840485	CIMMYT	SnpZM0018	CC	TT
7	S10_137904716	CIMMYT	SnpZM0019	CC	TT

CrtRB1: β -carotene hydroxylase1

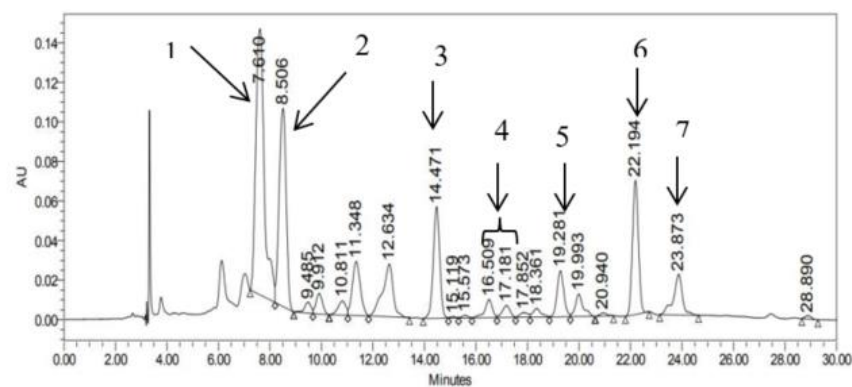
Table S3. Agroecological zones, average rainfall, temperature, relative humidity and soil type of the study locations.

Location	Agroecology	Average Rainfall /Month (mm)		Average Temperature/Month (°C)		Average Relative Humidity (%)		Soil Type (FAO Classification)
		2018	2019	2018	2019	2018	2019	
Ikenne	Rainforest	74.5	210.0	26.3	26.7	86.7	87.5	Luvisols, Acrisols, Ferrasols and Lithosols
Mokwa	Southern guinea savanna	60.8	144.3	27.5	27.6	65.0	66.1	Luvisol
Saminaka	Northern guinea savanna	58.2	136.1	25.7	24.8	47.8	54.4	Luvisols
Zaria	Sudan savanna	47.1	146.3	25.5	26.6	49.2	87.3	Luvisols

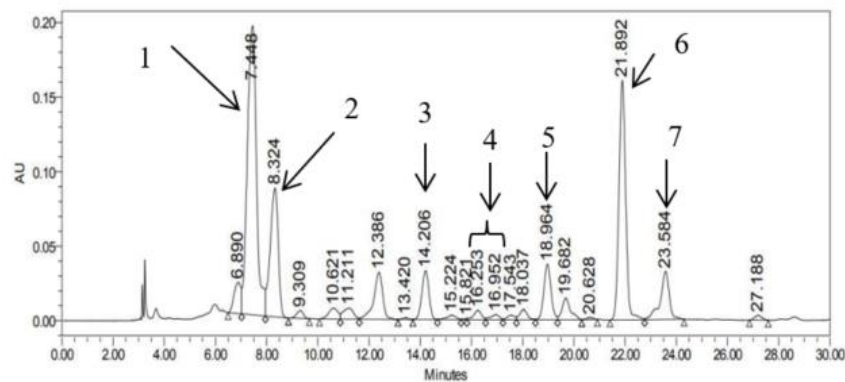
Source: IITA Geographic Information System.



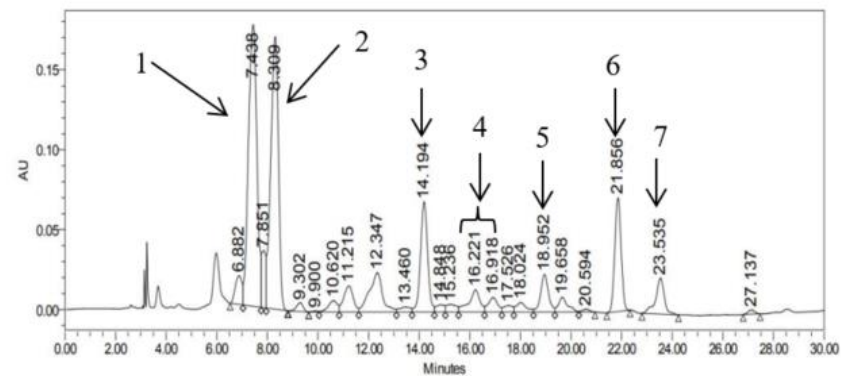
(A) PVASYNHGAC0



(B) PVASYNHGBC0

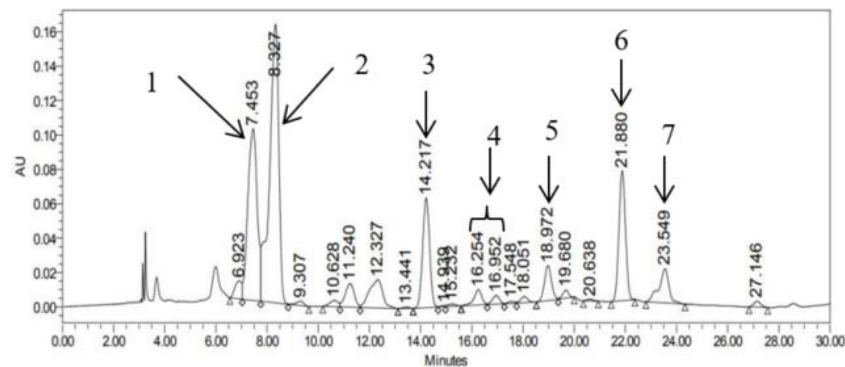


(C) PVASYNHGAC2

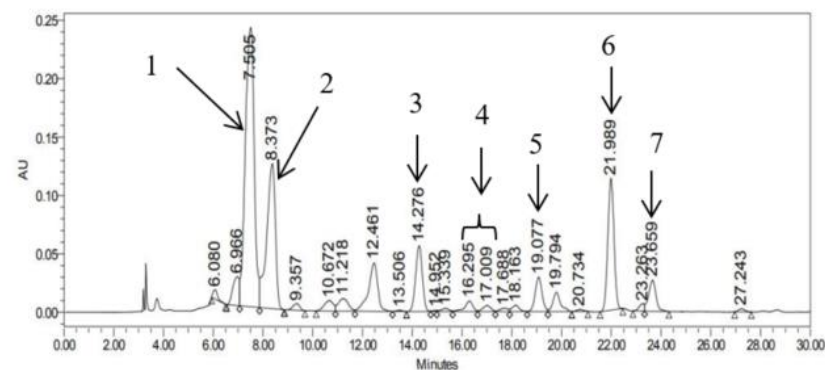


(D) PVASYNHGBC2

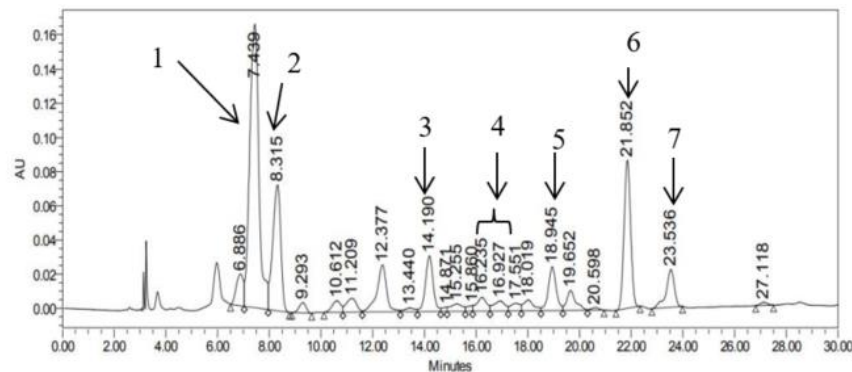
Figure S1a. Chromatograms of carotenoids of selection cycles of maize synthetics quantified using high performance liquid chromatography (HPLC) at the International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria. Peaks are (1) lutein (2) zeaxanthin (3) β -cryptoxanthin (4) α -carotene (5) 13-*cis* β -carotene (6) *trans* β -carotene (7) 9-*cis* β -carotene.



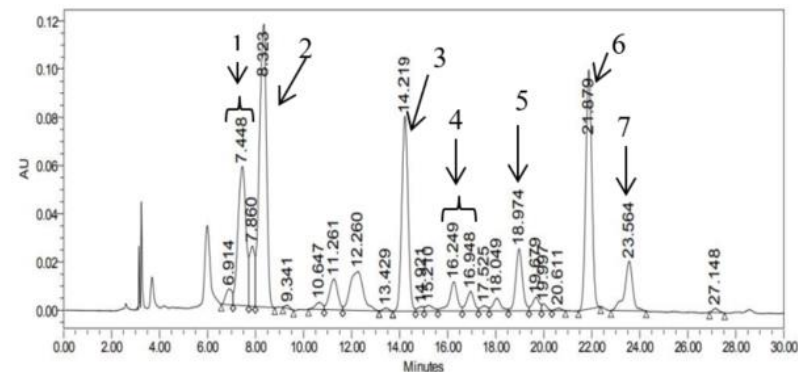
(E) PVASYNHBC0/PVASYNHGAC0



(F) PVASYNHBC2/PVASYNHGAC2



(G) PVASYNHBC1/PVASYNHGAC1



(H) PVASYN13

Figure S1b. Chromatograms of carotenoids of varietal-cross hybrids of maize and a (PVASYN13) quantified using High performance liquid chromatography (HPLC) at the International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria. Peaks are (1) lutein (2) zeaxanthin (3) β -cryptoxanthin (4) α -carotene (5) 13-*cis* β -carotene (6) *trans* β -carotene (7) 9-*cis* β -carotene.

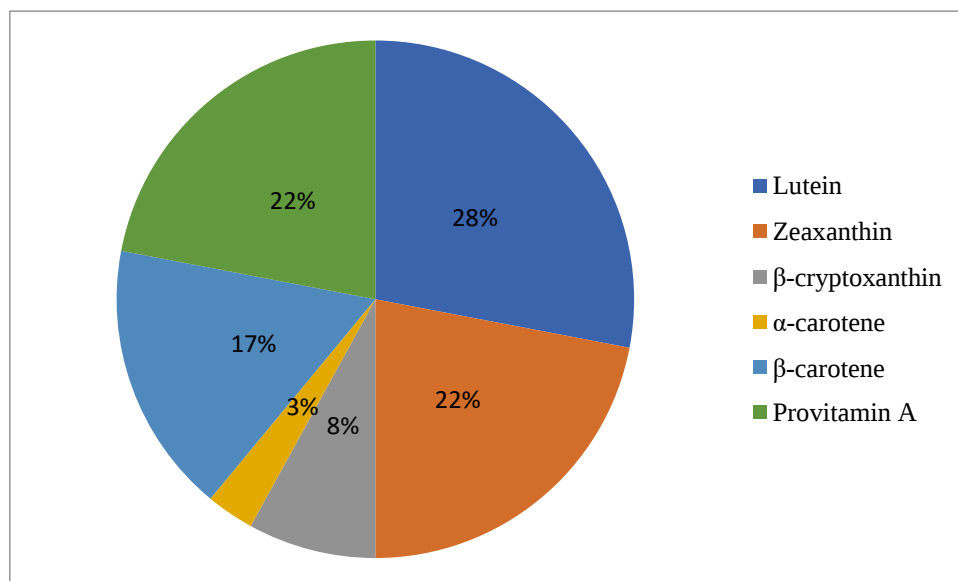


Figure S2. Proportions of carotenoids measured in maize parental synthetics, varietal-cross hybrids and a check evaluated across eight environments in Nigeria.