

Cubio tuber (*Tropaeolum tuberosum*, Tropaeolaceae) morphological diversity in Colombia and Bolivia

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Table 1. Morphological characterization of 15 cubio individuals based on tuber descriptors. Abbreviations: PSC, predominant surface color; CB, secondary surface color in bands; CD, secondary surface color in dots; CE, secondary surface color in eyes/buds; PPC, predominant pulp color; CC, secondary cortex color; VRC, secondary vascular ring color; PC, secondary pith color; TS, tuber shape; ED, eye/bud depth.

Accession	PSC	CB	CD	CE	PPC	CC	VCA	CP	F	ED
M2	Purple	Red	Absent	Absent	White	Purple	Purple	Grayish red	Fusiform conical	Slightly deep
A4	Intense yellow	Absent	Absent	Absent	Intense yellow	Absent	Absent	Absent	Fusiform conical	Slightly deep
AS6	Light yellow	Red	Black	Black	Yellowish white	Purple	Absent	Absent	Fusiform conical	Very deep
A7	Intense yellow	Red	Absent	Absent	Yellow	Absent	Absent	Absent	Fusiform conical	Deep
M8	Yellowish white	Absent	Grayish purple	Grayish purple	White	Purple	Purple	Grayish red	Fusiform conical	Very deep
M10	Yellowish white	Absent	Purple	Purple	Yellowish white	Purple	Purple	Absent	Fusiform conical	Deep
AS11	Light yellow	Absent	Absent	Purple	Yellowish white	Absent	Purple	Grayish red	Fusiform conical	Deep
M12	Yellowish white	Red	Purple	Purple	Yellowish white	Purple	Purple	Grayish red	Fusiform conical	Deep
B15	Yellowish white	Absent	Absent	Purple	White	Absent	Purple	Absent	Fusiform cylindrical	Slightly deep
AS17	Intense yellow	Red	Red	Absent	Yellow	Light red	Absent	Absent	Fusiform conical	Deep
AS18	Yellowish white	Red	Grayish purple	Grayish purple	White	Purple	Purple	Purple	Fusiform conical	Deep
IS1	Black	Red	Absent	Absent	White	Purple	Purple	Grayish red	Fusiform conical	Slightly deep
IS2	Yellow-orange	Absent	Absent	Absent	Orange-yellow	Absent	Absent	Absent	Fusiform conical	Deep
IS3	Light yellow	Absent	Absent	Dark green	White	Absent	Absent	Absent	Conical	Very deep
IS4	Yellowish white	Yellow	Absent	Light yellow	White	Absent	Absent	Absent	Fusiform conical	Deep

Table 2. Morphological characterization of 15 cubio individuals, based on tuber descriptors and incorporating the dataset from Manrique *et al.* (2014). Abbreviations: PSC, predominant surface color; CB, secondary surface color in bands; CD, secondary surface color in dots; CE, secondary surface color in eyes/buds; PPC, predominant pulp color; CC, secondary cortex color; VRC, secondary vascular ring color; PC, secondary pith color; TS, tuber shape; ED, eye/bud depth.

Accession	PSC	CB	CD	CE	PPC	CC	VCA	CP	F	ED
M2	Purple	Light red	Absent	Absent	White	Purple	Purple	Grayish red	White	Yellowish white
A4	Intense yellow	Absent	Absent	Absent	Intense yellow	Absent	Absent	Absent	Yellowish white	Yellowish white
AS6	Light yellow	Light red	Black	Black	Yellowish white	Purple	Absent	Absent	Light yellow	Yellowish white
A7	Intense yellow	Light red	Absent	Absent	Yellow	Absent	Absent	Absent	Yellowish white	Yellowish white
M8	Yellowish white	Absent	Grayish purple	Grayish purple	White	Purple	Purple	Grayish red	Light yellow	Yellowish white
M10	Yellowish white	Absent	Purple	Purple	Yellowish white	Purple	Purple	Absent	Yellowish white	Yellowish white
AS11	Light yellow	Absent	Absent	Purple	Yellowish white	Absent	Purple	Grayish red	Yellowish white	Yellowish white
M12	Yellowish white	Light red	Purple	Purple	Yellowish white	Purple	Purple	Grayish red	Light yellow	Yellowish white
B15	Yellowish white	Absent	Absent	Purple	White	Absent	Purple	Absent	White	Light yellow
AS17	Intense yellow	Light red	Light red	Absent	Yellow	Red	Absent	Absent	Yellowish white	Yellowish white
AS18	Yellowish white	Light red	Grayish purple	Grayish purple	White	Purple	Purple	Purple	Yellowish white	Yellowish white
IS1	Black	Light red	Absent	Absent	White	Purple	Purple	Grayish red	White	Yellowish white
IS2	Yellow orange	Absent	Absent	Absent	Orange yellow	Absent	Absent	Absent	Yellowish white	Yellowish white
IS3	Light yellow	Absent	Absent	Dark green	White	Absent	Absent	Absent	Light yellow	White
IS4	Yellowish white	Yellow	Absent	Light yellow	White	Absent	Absent	Absent	Yellowish white	Yellowish white
AMM 5134	Yellow orange	Absent	Absent	Purple	Orange yellow	Absent	Absent	Absent	White	White
AMM 5159	Yellow orange	Absent	Grayish red	Grayish red	Orange yellow	Absent	Absent	Absent	Yellowish white	Yellowish white
AMM 5160	Yellow orange	Absent	Absent	Absent	Yellow	Absent	Absent	Absent	Yellowish white	White
T 40-84	Yellow orange	Grayish red	Absent	Grayish red	Yellow	Absent	Absent	Absent	Yellowish white	Yellowish white
T 147 85	Intense yellow	Absent	Absent	Absent	Yellow	Absent	Absent	Absent	White	Yellowish white

Continúa en la siguiente página

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Accession	CPS	CB	CP	CO	CPP	CC	CA	CM	P	F
ARB 5072	Yellow orange	Absent	Absent	Purple	Orange yellow	Absent	Absent	Absent	White	Yellowish white
AGM 5108	Light yellow	Absent	Absent	Absent	Yellow	Absent	Absent	Absent	White	Yellowish white
AGM 5109	Brown	Absent	Absent	Yellow	Orange yellow	Brown	Absent	Absent	White	Yellowish white
AGM 5110	Light yellow	Absent	Absent	Purple	Yellowish white	Absent	Absent	Absent	White	Light yellow
AGM 5111	Yellow orange	Absent	Absent	Purple	Orange yellow	Absent	Absent	Absent	White	Light yellow
AGM 5113	Intense yellow	Purple	Absent	Purple	Yellow	Absent	Absent	Absent	White	Yellowish white
AGM 5115	Light yellow	Absent	Absent	Red	Yellowish white	Absent	Absent	Absent	White	Yellowish white
AGM 5116	Intense yellow	Purple	Purple	Purple	Yellow	Absent	Absent	Absent	White	Yellowish white
AGM 5118	Brown	Absent	Absent	Yellow	Orange yellow	Brown	Absent	Absent	White	Yellowish white
AGM 5119	Intense yellow	Grayish red	Grayish red	Grayish red	Yellow	Absent	Absent	Absent	White	Yellowish white
AJB 5314	Intense yellow	Grayish red	Grayish red	Grayish red	Yellow	Absent	Absent	Absent	White	Yellowish white
AJB 5318	Light yellow	Absent	Absent	Absent	Yellow	Absent	Absent	White	White	Yellowish white
AJB 5322	Yellow orange	Absent	Absent	Absent	Orange yellow	Absent	Absent	Absent	White	Light yellow
ARB 5238	Yellow orange	Absent	Absent	Purple	Orange yellow	Absent	Absent	Absent	Yellowish white	White
ARB 5239	Yellow orange	Absent	Absent	Purple	Orange yellow	Absent	Absent	Absent	Yellowish white	White
ARB 5240	Yellowish white	Purple	Absent	Purple	Yellowish white	Absent	Absent	Absent	Yellowish white	Yellowish white
ARB 5241	Grayish purple	Purple	Absent	Purple	Orange yellow	Purple	Absent	Absent	Yellowish white	Light yellow
ARB 5242	Yellow orange	Absent	Purple	Purple	Orange yellow	Absent	Absent	Absent	Yellowish white	Yellowish white
MH 1160	Yellowish white	Absent	Purple	Purple	White	Absent	Purple	Absent	Yellowish white	White
MH 1157	Yellowish white	Red	Purple	Red	White	Absent	Yellow	Absent	White	Yellowish white

Continúa en la siguiente página

Table 2. Morphological characterization of 15 cubio individuals, based on tuber descriptors and incorporating the dataset from Manrique *et al.* (2014). Abbreviations: PSC, predominant surface color; CB, secondary surface color in bands; CD, secondary surface color in dots; CE, secondary surface color in eyes/buds; PPC, predominant pulp color; CC, secondary cortex color; VRC, secondary vascular ring color; PC, secondary pith color; TS, tuber shape; ED, eye/bud depth.

Accession	CPS	CB	CP	CO	CPP	CC	CA	CM	P	F
MH 1161	Yellow orange	Absent	Purple	Purple	Orange yellow	Absent	Absent	Absent	Yellowish white	Yellowish white
PCP 056	Yellow orange	Absent	Absent	Absent	Yellow	Absent	Absent	Absent	Yellowish white	Yellowish white
ARB 5237	Yellow orange	Absent	Grayish red	Grayish red	Orange yellow	Absent	Absent	Absent	Yellowish white	Yellowish white
T 5-83	Intense yellow	Light red	Absent	Light red	Yellow	Absent	Absent	Absent	Yellowish white	White
T 1-83	Yellow orange	Absent	Absent	Absent	Orange yellow	Absent	Absent	Absent	Light yellow	White
GOM 88	Intense yellow	Absent	Absent	Absent	Yellow	Absent	Absent	Absent	Yellowish white	Yellowish white
GOM 89	Intense yellow	Absent	Absent	Absent	Yellow	Absent	Absent	Absent	Yellowish white	Yellowish white
GOM 91	Intense yellow	Light red	Absent	Light red	Yellow	Absent	Absent	Absent	Yellowish white	Yellowish white
GOM 92	Light yellow	Absent	Purple	Purple	Yellowish white	Absent	Purple	Absent	White	Yellowish white
GOM 93	Light yellow	Absent	Purple	Purple	Yellowish white	Absent	Purple	Absent	White	Yellowish white
GOM 94	Light yellow	Absent	Purple	Purple	Yellowish white	Absent	Purple	Absent	White	Yellowish white
GOM 96	Light yellow	Absent	Purple	Purple	Yellowish white	Absent	Purple	Absent	Yellowish white	Yellowish white
AVM 5556	Yellow orange	Absent	Grayish red	Grayish red	Orange yellow	Absent	Absent	Absent	Yellowish white	White
AVM 5557	Light yellow	Absent	Absent	Red	Yellowish white	Absent	Absent	Absent	Yellowish white	Yellowish white
AVM 5558	Yellow orange	Absent	Absent	Absent	Orange yellow	Absent	Absent	Absent	Yellowish white	White
AVM 5559	Intense yellow	Absent	Absent	Light red	Yellow	Absent	Absent	Absent	Yellowish white	White
AVM 5560	Intense yellow	Purple	Absent	Purple	Yellow	Absent	Absent	Absent	Yellowish white	Yellowish white
AVM 5561	Light yellow	Absent	Absent	Purple	Yellowish white	Absent	Absent	Absent	White	Light yellow
AVM 5562	Yellow orange	Absent	Absent	Absent	Orange yellow	Absent	Absent	Absent	Yellowish white	White
ARB 5575	Intense yellow	Light red	Light red	Light red	Yellow	Absent	Absent	Absent	Light yellow	White

Continúa en la siguiente página

Table 2. Morphological characterization of 15 cubio individuals, based on tuber descriptors and incorporating the dataset from Manrique *et al.* (2014). Abbreviations: PSC, predominant surface color; CB, secondary surface color in bands; CD, secondary surface color in dots; CE, secondary surface color in eyes/buds; PPC, predominant pulp color; CC, secondary cortex color; VRC, secondary vascular ring color; PC, secondary pith color; TS, tuber shape; ED, eye/bud depth.

Accession	CPS	CB	CP	CO	CPP	CC	CA	CM	P	F
ARB 5576	Yellow orange	Absent	Absent	Red	Orange yellow	Absent	Absent	Absent	Yellowish white	White
ARB 5577	Yellow orange	Absent	Absent	Absent	Orange yellow	Absent	Absent	Absent	Yellowish white	White
ARB 5578	Light yellow	Absent	Absent	Absent	Yellowish white	Absent	Absent	Absent	White	Yellowish white
ARB 5579	Light yellow	Purple	Absent	Purple	Yellowish white	Absent	Purple	Absent	Yellowish white	Yellowish white
ARB 5580	Yellow orange	Absent	Absent	Red	Orange yellow	Absent	Absent	Absent	White	Yellowish white
ARB 5581	Light yellow	Absent	Absent	Absent	Yellowish white	Absent	Absent	Absent	Yellowish white	Yellowish white
ARB 5582	Intense yellow	Absent	Absent	Absent	Yellow	Absent	Absent	Absent	Yellowish white	Yellowish white
T 33-84	Yellow orange	Absent	Absent	Purple	Orange yellow	Absent	Absent	Absent	White	Light yellow
T 36-84	Light yellow	Absent	Absent	Purple	Yellowish white	Absent	Purple	Absent	White	Yellowish white
T 12-83a	Light yellow	Absent	Absent	Purple	Yellowish white	Yellow	Absent	Absent	White	White
CM DPA 02 02	Yellowish white	Absent	Purple	Purple	White	Absent	Purple	Absent	Yellowish white	White
CM DPA 02 03	Yellow orange	Absent	Absent	Absent	Orange yellow	Absent	Absent	Absent	Yellowish white	White
CM DPA 02 04	Yellow orange	Absent	Grayish red	Grayish red	Orange yellow	Absent	Absent	Absent	White	Light yellow
CM DPA 02 05	Yellow orange	Absent	Absent	Purple	Orange yellow	Absent	Absent	Absent	Yellowish white	Yellowish white
CM DPA 02 05b	Yellow orange	Absent	Grayish red	Grayish red	Orange yellow	Absent	Absent	Absent	Yellowish white	Yellowish white
CM DPA 02 07	Yellow orange	Absent	Absent	Absent	Orange yellow	Absent	Absent	Absent	Yellowish white	Yellowish white
CM DPA 02 08	Yellow orange	Absent	Absent	Red	Orange yellow	Absent	Absent	Absent	White	Yellowish white
CM DPA 02 08a	Yellow orange	Absent	Absent	Purple	Orange yellow	Absent	Absent	Absent	Yellowish white	White
CM DPA 02 09	Intense yellow	Purple	Absent	Purple	Yellow	Absent	Absent	Absent	Yellowish white	White
CM DPA 02 13	Yellow orange	Absent	Absent	Purple	Orange yellow	Absent	Absent	Absent	White	White

Continúa en la siguiente página

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Accession	CPS	CB	CP	CO	CPP	CC	CA	CM	P	F
CM DPA 02 13a	Yellow orange	Absent	Absent	Red	Orange yellow	Absent	Absent	Absent	Yellowish white	Yellowish white
CM DPA 02 15	Yellow orange	Absent	Absent	Absent	Orange yellow	Absent	Absent	Absent	Yellowish white	Yellowish white
CM DPA 02 16	Yellow orange	Absent	Absent	Purple	Orange yellow	Absent	Absent	Absent	Yellowish white	White
CM DPA 02 18	Yellow orange	Absent	Absent	Absent	Orange yellow	Absent	Absent	Absent	Yellowish white	Yellowish white
CM DPA 02 20	Yellow orange	Absent	Absent	Absent	Orange yellow	Absent	Absent	Absent	Yellowish white	White
CM DPA 02 22	Intense yellow	Absent	Absent	Light red	Yellow	Absent	Absent	Absent	Light yellow	White
CM DPA 02 23	Yellow orange	Absent	Absent	Absent	Orange yellow	Absent	Absent	Absent	Yellowish white	Yellowish white
CM DPA 02 24	Black	Absent	Absent	Absent	Purple	Absent	Absent	Absent	Yellowish white	White
AAQ 5488	Intense yellow	Absent	Absent	Light red	Yellow	Absent	Absent	Absent	White	Yellowish white
ARV 5364	Yellow orange	Grayish red	Absent	Grayish red	Orange yellow	Absent	Absent	Absent	Yellowish white	Yellowish white
ARV 5365	Light yellow	Light red	Light red	Light red	Yellow	Absent	Absent	Absent	Yellowish white	Yellowish white
ARV 5366	Intense grayish red	Light red	Absent	Light red	White	Purple	Absent	Absent	Yellowish white	White
ARV 5367	Yellowish white	Absent	Absent	Purple	Yellowish white	Absent	Absent	Absent	White	Light yellow
ARV 5368	Intense yellow	Absent	Absent	Purple	Yellow	Absent	Absent	Absent	White	Light yellow
ARV 5369	Intense yellow	Absent	Absent	Purple	Yellow	Absent	Absent	Absent	White	Light yellow
ARV 5370	Grayish red	Yellow	Yellow	Yellow	Orange yellow	Absent	Absent	Absent	Yellowish white	Yellowish white
ARV 5371	Intense yellow	Absent	Absent	Purple	Yellow	Absent	Absent	Absent	White	Light yellow
M 01 COL 1A	Yellow orange	Absent	Grayish red	Grayish red	Orange yellow	Absent	Absent	Absent	Yellowish white	Yellowish white
M 01 COL 1A*	Intense yellow	Purple	Purple	Purple	Yellow	Absent	Absent	Absent	White	Yellowish white
M 02 COL 1B	Yellow orange	Absent	Absent	Purple	Orange yellow	Absent	Absent	Absent	White	Yellowish white

Continúa en la siguiente página

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Accession	CPS	CB	CP	CO	CPP	CC	CA	CM	P	F
M 02 O CO	Yellow orange	Purple	Absent	Purple	Yellow	Absent	Absent	Absent	Yellowish white	Yellowish white
M 04 COL 2A	Intense yellow	Absent	Absent	Red	Yellow	Absent	Absent	Absent	White	Yellowish white
M 04 COL 5C	Intense yellow	Purple	Purple	Purple	Yellow	Absent	Absent	Absent	White	Yellowish white
M 05 COL 2B	Yellow orange	Absent	Absent	Red	Orange yellow	Absent	Absent	Absent	Yellowish white	White
M 06 COL 2C	Yellow orange	Absent	Absent	Absent	Orange yellow	Absent	Absent	Absent	Yellowish white	White
M 07 COL 3A	Intense yellow	Light red	Absent	Light red	Yellowish white	Yellow	Absent	Absent	Yellowish white	Yellowish white
M 08 COL 3B	Intense yellow	Purple	Purple	Purple	Yellow	Absent	Absent	Absent	White	Yellowish white
M 09 COL 3C	Yellow orange	Grayish red	Grayish red	Grayish red	Orange yellow	Absent	Absent	Absent	Yellowish white	White
M 10 COL 3B	Intense yellow	Purple	Purple	Purple	Yellow	Absent	Absent	Absent	White	Yellowish white
M 11 COL 3E	Intense yellow	Absent	Absent	Red	Yellow	Absent	Absent	Absent	White	Yellowish white
M 12 COL 3F	Light yellow	Absent	Purple	Purple	Yellowish white	Absent	Purple	Absent	Yellowish white	Yellowish white
M 13 COL 4A	Intense grayish red	Absent	Yellow	Yellow	Yellow	Grayish red	Absent	Absent	Yellowish white	Yellowish white
M 14 COL 4B	Yellow orange	Absent	Absent	Purple	Yellow	Absent	Absent	Absent	White	Yellowish white
M 15 COL 5A	Yellow orange	Absent	Absent	Absent	Orange yellow	Absent	Absent	Absent	Yellowish white	White
M 16 COL 5B	Intense yellow	Purple	Purple	Purple	Yellow	Absent	Absent	Absent	White	Yellowish white
M 17 COL 6A	Light yellow	Absent	Purple	Purple	Yellowish white	Absent	Purple	Absent	Yellowish white	Yellowish white
M 19 COL 6	Intense yellow	Absent	Red	Red	Yellow	Absent	Absent	Absent	Yellowish white	Yellowish white
M 21 COL 7B	Light yellow	Absent	Purple	Purple	Yellowish white	Absent	Purple	Absent	Yellowish white	Yellowish white
M 22 COL 7	Intense yellow	Light red	Light red	Light red	Yellowish white	Yellow	Absent	Absent	Yellowish white	Yellowish white
M 23 COL 7D	Intense yellow	Absent	Absent	Absent	Yellow	Absent	Absent	Absent	Yellowish white	White

Continúa en la siguiente página

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Accession	CPS	CB	CP	CO	CPP	CC	CA	CM	P	F
M 24	Light yellow	Absent	Purple	Purple	Yellowish white	Absent	Purple	Absent	Yellowish white	Yellowish white
COL 7B	Yellow	Absent	Purple	Purple	Orange yellow	Absent	Absent	Absent	Yellowish white	Yellowish white
PICA PL	Yellow	Absent	Purple	Purple	Orange yellow	Absent	Absent	Absent	Yellowish white	Yellowish white
92 MA	orange									

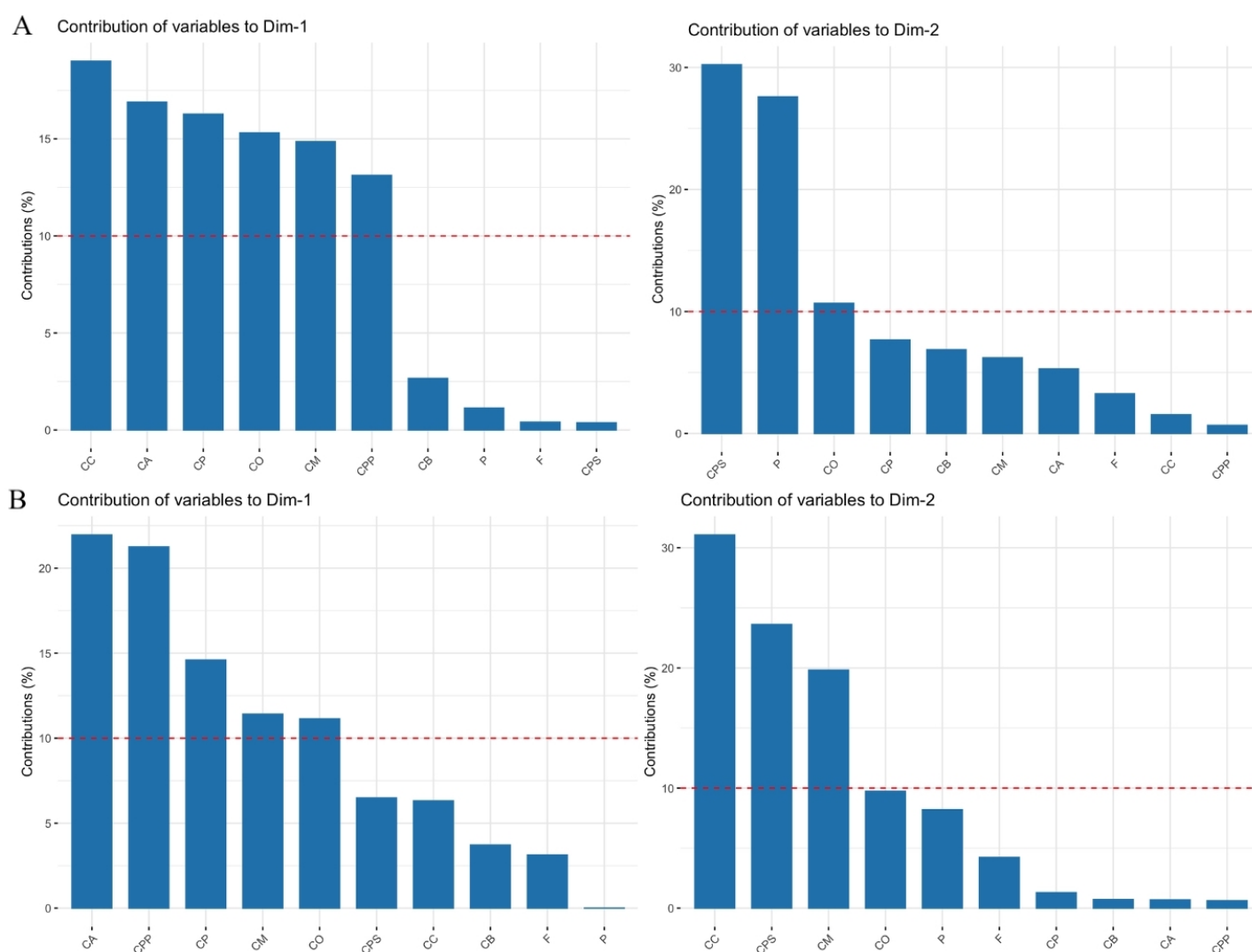


Figure 1. Contribution of variables to dimensions 1 (left) and 2 (right) of the Principal Component Analysis (PCA) based on the morphological characterization of tubers from a dataset of 15 cubio individuals under study (A) and including the dataset from Manrique *et al.* (2014) (B).