

Supplementary Material

The effect of *Helichrysum* shrub encroachment on orchids in a tropical, montane grassland ecosystem, Tanzania

Christopher A. Mgimba^{A,B,*}, *Issakwisa B. Ngondya*^A, and *Anna C. Treydte*^{A,C,D}

^A Department of Sustainable Agriculture, Biodiversity and Ecosystem Management, School of Life Sciences and Bio-engineering, The Nelson Mandela African Institution of Science and Technology, Arusha, Tanzania.

^B Department of Earth Sciences, Mbeya University of Science and Technology, Mbeya, Tanzania.

^C Department of Physical Geography, Stockholm University, Stockholm 106 91, Sweden.

^D Ecology of Tropical Agricultural Systems, Hans Ruthenberg Institute, University of Hohenheim, Stuttgart, Germany.

*Correspondence to: Christopher A. Mgimba Department of Sustainable Agriculture, Biodiversity and Ecosystem Management, School of Life Sciences and Bio-engineering, The Nelson Mandela African Institution of Science and Technology, Arusha, Tanzania Email: mgimbac@nm-aist.ac.tz

Table S1: Mean (\pm SE) specific leaf Area (SLA, in cm^2/g) of leaves of different orchid species across treatment categories. The mean values with different letters in the same column are significantly different at $p < 0.05$ across treatments according to the Tukey test at $p < 0.05$.

Orchid species	Treatments across seasons							
	Season 1				Season 2			
	high cover	low cover	stem cut	uprooted	high cover	low cover	stem cut	uprooted
<i>D. erubescens</i>	79.6 \pm 12.7a	21.4 \pm 1.7c	41.6 \pm 7.3b	40.8 \pm 4.6b	66.8 \pm 3.2a	20.2 \pm 1.5b	25.6 \pm 2b	19.3 \pm 2b
<i>D. robusta</i>	86.8 \pm 11.1a	27.6 \pm 4.1b	19.1 \pm 0.7b	16.7 \pm 0.7b	96.5 \pm 14.1a	21.9 \pm 0.4b	21.9 \pm 0.8b	22.4 \pm 0.8b
<i>H. occlusa</i>	19.5 \pm 3.5b	17.1 \pm 2.0b	36 \pm 5.5a	13.2 \pm 0.6b	25.3 \pm 1.7b	19.2 \pm 1.3b	30.6 \pm 7.5a	15.2 \pm 1.4b
<i>S. acutirostrum</i>	97.6 \pm 11.6a	15.9 \pm 1.1c	31 \pm 2.4b	21.2 \pm 1.5b	125.7 \pm 17.9a	33.3 \pm 3.4b	32.6 \pm 7.6b	33.7 \pm 7.5b
<i>S. longicauda</i>	66.3 \pm 23.4a	20.6 \pm 1.2b	25.5 \pm 2.4b	24.0 \pm 1.1b	21.9 \pm 2.2b	22.7 \pm 1.5b	44.4 \pm 10.3a	23.3 \pm 1.4b
<i>S. sphaeranthum</i>	86.7 \pm 12.0a	21 \pm 2.8b	19.4 \pm 0.9b	17.5 \pm 0.8b	139.4 \pm 0a	22.8 \pm 1.1b	26.7 \pm 5.8b	22.6 \pm 1.5b

Table S2: Mean (\pm SE) Leaf Dry Matter Content (LDMC) in leaves of different orchid species across treatment categories. The mean values with different letters in the same column are significantly different at $p < 0.05$ according to the Tukey test at $p < 0.05$.

Orchid species	Treatments across seasons							
	Season 1				Season 2			
	high cover	low cover	stem cut	uprooted	high cover	low cover	stem cut	uprooted
<i>D. erubescens</i>	0.15 \pm 0.02c	0.30 \pm 0.03a	0.22 \pm 0.02b	0.19 \pm 0.02b	0.16 \pm 0.00b	0.22 \pm 0.02a	0.32 \pm 0.02a	0.35 \pm 0.02a
<i>D. robusta</i>	0.11 \pm 0.01b	0.29 \pm 0.04a	0.36 \pm 0.01a	0.40 \pm 0.01a	0.11 \pm 0.01b	0.38 \pm 0.01a	0.34 \pm 0.01a	0.31 \pm 0.02a
<i>H. occlusa</i>	0.35 \pm 0.04a	0.26 \pm 0.02a	0.18 \pm 0.04b	0.36 \pm 0.02a	0.18 \pm 0.05a	0.26 \pm 0.04a	0.27 \pm 0.01a	0.31 \pm 0.02a
<i>S. acutirostrum</i>	0.15 \pm 0.02c	0.36 \pm 0.02a	0.25 \pm 0.01b	0.28 \pm 0.01b	0.08 \pm 0.01b	0.33 \pm 0.03a	0.27 \pm 0.02a	0.24 \pm 0.02a
<i>S. longicauda</i>	0.11 \pm 0.02b	0.34 \pm 0.01a	0.29 \pm 0.03a	0.29 \pm 0.01a	0.11 \pm 0.03b	0.30 \pm 0.01a	0.22 \pm 0.01a	0.30 \pm 0.00a
<i>S. sphaeranthum</i>	0.07 \pm 0.03b	0.35 \pm 0.05a	0.33 \pm 0.03a	0.33 \pm 0.01a	0.04 \pm 0.03b	0.29 \pm 0.04a	0.29 \pm 0.02a	0.30 \pm 0.01a

Table S3: Mean (\pm SE) Dark Green Color Index (DGCI) values in leaves of different orchid species across treatment categories. The mean values with different letters in the same column are significantly different at $p < 0.05$ according to the Tukey test at $p < 0.05$.

Orchid species	Treatments across seasons							
	Season 1				Season 2			
	high cover	low cover	stem cut	uprooted	high cover	low cover	stem cut	uprooted
<i>D. erubescens</i>	0.42 \pm 0.02b	0.57 \pm 0.04a	0.48 \pm 0.01a	0.52 \pm 0.03a	0.36 \pm 0.00b	0.55 \pm 0.04a	0.56 \pm 0.04a	0.57 \pm 0.03a
<i>D. robusta</i>	0.39 \pm 0.01c	0.50 \pm 0.03a	0.45 \pm 0.02b	0.46 \pm 0.02b	0.46 \pm 0.04b	0.47 \pm 0.04b	0.63 \pm 0.04a	0.52 \pm 0.03b
<i>H. occlusa</i>	0.4 \pm 0.01c	0.54 \pm 0.04a	0.46 \pm 0.02a	0.50 \pm 0.03a	0.39 \pm 0.01c	0.45 \pm 0.01b	0.6 \pm 0.05a	0.47 \pm 0.04b
<i>S. acutirostrum</i>	0.72 \pm 0.03a	0.48 \pm 0.05b	0.50 \pm 0.03b	0.48 \pm 0.01b	0.65 \pm 0.04a	0.52 \pm 0.03b	0.42 \pm 0.01b	0.50 \pm 0.03b
<i>S. longicauda</i>	0.42 \pm 0.05b	0.46 \pm 0.02a	0.44 \pm 0.02ba	0.48 \pm 0.02a	0.38 \pm 0.03b	0.54 \pm 0.04a	0.44 \pm 0.01a	0.50 \pm 0.03a
<i>S. sphaeranthum</i>	0.80 \pm 0.01a	0.46 \pm 0.03b	0.50 \pm 0.02b	0.42 \pm 0.00b	0.69 \pm 0.04a	0.44 \pm 0.02b	0.48 \pm 0.0b	0.51 \pm 0.03b