



Multifunctional Cover Crops for Sustainable Intensification: Agronomic Performance, Weed Suppression and Soil Quality in Cameroon

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Tropentag 2026
“Towards multi-functional agro-ecosystems promoting climate resilient futures”
September 16–18, 2026,
hybrid conference
Universities of Kassel and Göttingen

Introduction

- Smallholder systems in Cameroon’s humid tropics face declining soil fertility, persistent weed pressure and growing herbicide dependence, especially on the volcanic soils around Mount Cameroon
- Herbaceous cover crops offer a low-input route to sustainable intensification – biological N fixation, rapid canopy closure and weed suppression without herbicides
- Comparative multi-species evidence for agro-ecological zone IV (foot of Mount Cameroon) remains scarce

Objective

- Evaluate the agronomic performance, weed-suppressive ability and soil-chemical effects of five cover crops relative to a weedy fallow, to identify species suited to climate-resilient, low-herbicide cropping systems

Materials and Methods

- Field trial, May–October 2024, University of Buea Teaching and Research Farm, Fako Division, South-West Region, Cameroon (agro-ecological zone IV)
- Randomised Complete Block Design, 4 replicates, 24 plots (3 × 4 m)
- Treatments: *Mucuna pruriens*, *Cajanus cajan*, *Stylosanthes guianensis*, *Crotalaria juncea*, *Crotalaria retusa*, plus an unplanted weedy fallow control
- Measured: nodulation (8 WAP), canopy cover (biweekly, Braun-Blanquet scale), fresh/dry biomass and weed density (8 & 12 WAP), and soil pH, organic matter/carbon, total N, available P and exchangeable Ca, Mg, K (baseline vs. post-treatment)
- Statistics: one-way ANOVA with Tukey’s HSD (or Kruskal-Wallis/Dunn’s where assumptions were violated); paired t-test/Wilcoxon for baseline-vs-post soil values; rank-summation index across functional domains

Results – Agronomic Performance

- M. pruriens* formed significantly more root nodules than all other species at 8 WAP (9.33 ± 0.33 ; $p < 0.001$) and achieved the fastest canopy closure ($97.2 \pm 1.2\%$ by Week 12)
- C. retusa* produced the highest total dry biomass at 12 WAP ($5.76 \pm 0.67 \text{ t ha}^{-1}$), significantly exceeding all four other species ($p < 0.05$)
- S. guianensis* was consistently the weakest performer across nodulation, canopy cover and biomass
- Agronomic rank order: *C. retusa* > *M. pruriens* > *C. cajan* > *C. juncea* > *S. guianensis*

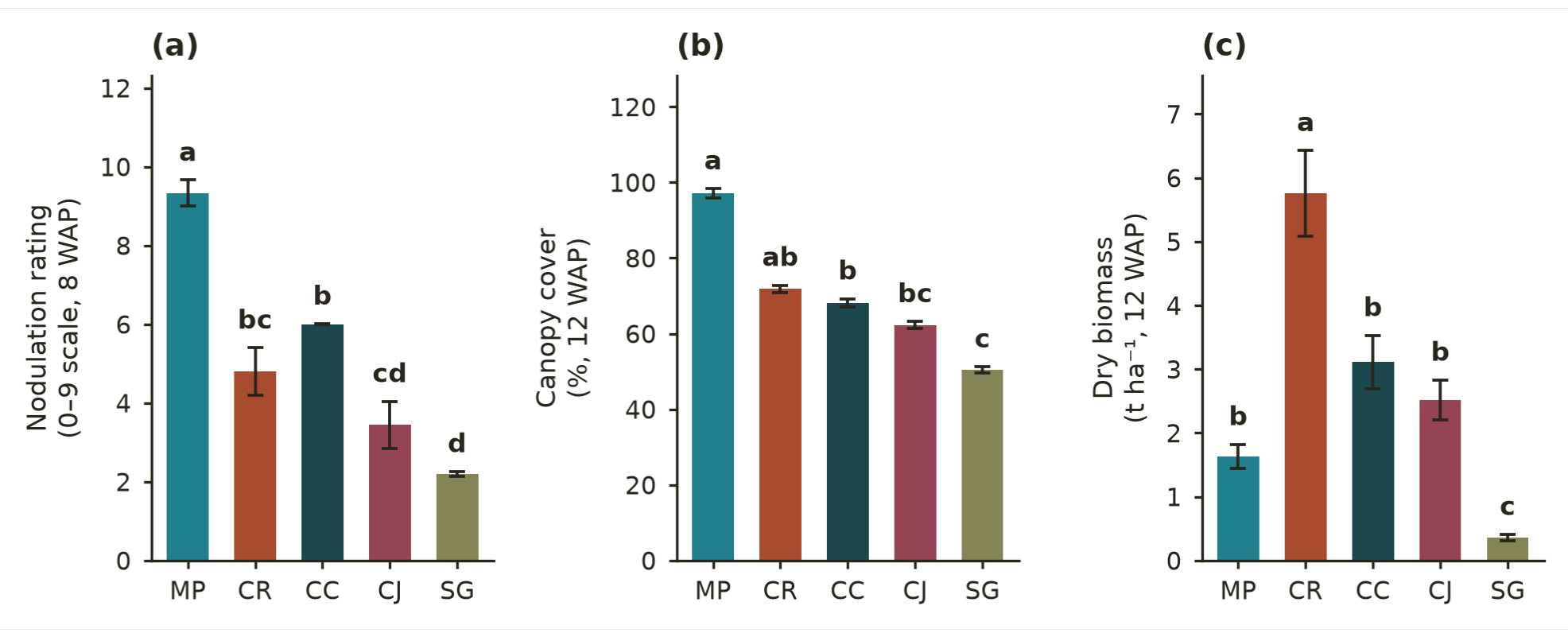


Figure 1. Mean ($\pm$ SE) (a) nodulation rating at 8 WAP, (b) canopy cover at 12 WAP, and (c) total dry biomass at 12 WAP for five cover crop species (MP = *M. pruriens*, CR = *C. retusa*, CC = *C. cajan*, CJ = *C. juncea*, SG = *S. guianensis*), University of Buea Teaching and Research Farm, 2024. Bars sharing no common letter differ significantly within each panel (Tukey’s HSD, $p < 0.05$).

Results – Weed Suppression

- M. pruriens* reduced weed fresh biomass at 12 WAP to $0.32 \pm 0.32 \text{ t ha}^{-1}$, about 98% below the weedy fallow ($14.47 \pm 1.24 \text{ t ha}^{-1}$; $p < 0.0001$) – the only treatment differing significantly from the fallow
- S. guianensis* was the least effective weed suppressor among the cover crops, reflecting its slower establishment and more open canopy

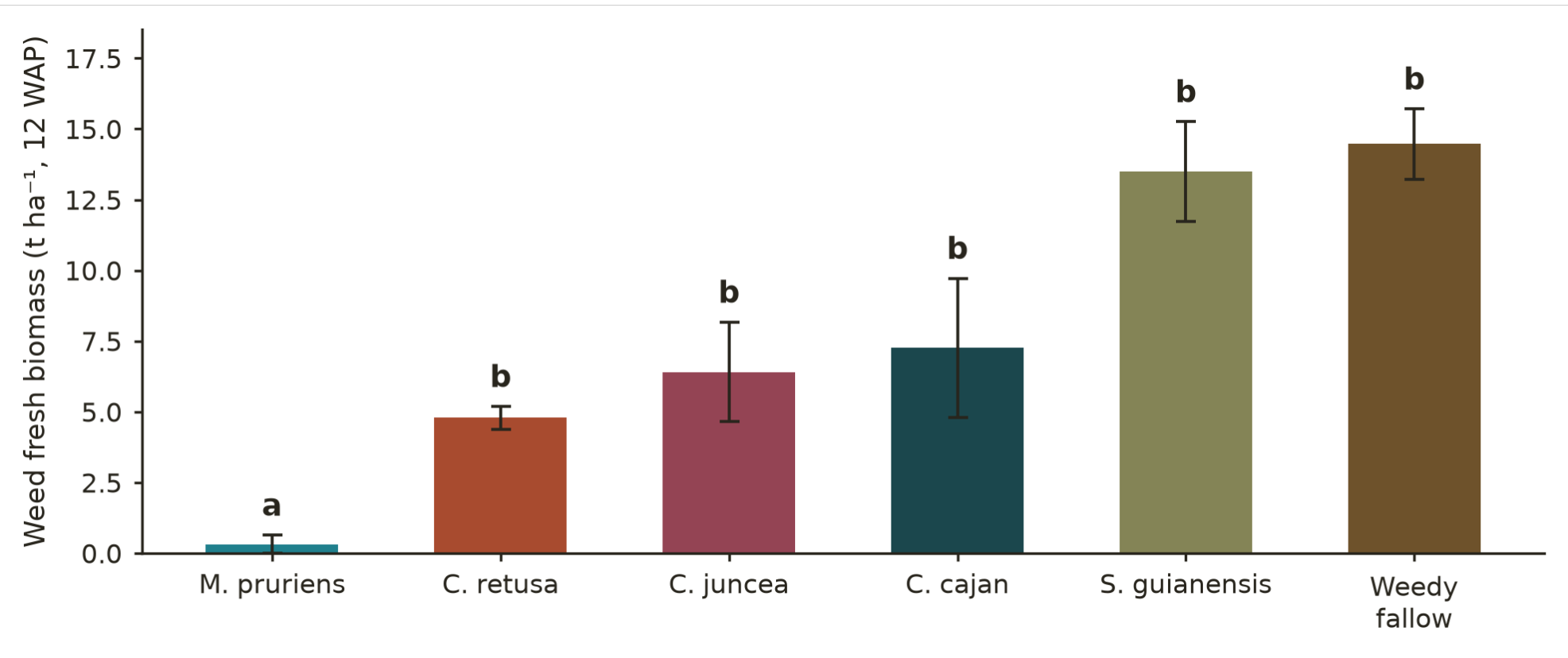


Figure 2. Mean ($\pm$ SE) weed fresh biomass at 12 WAP under five cover crop treatments and a weedy fallow control, University of Buea Teaching and Research Farm, 2024. Bars sharing no common letter differ significantly (Tukey’s HSD, $p < 0.05$).

Results – Soil Chemistry

- Cover cropping significantly raised soil pH (+7.1%), organic matter (+10.7%) and organic carbon (+16.1%) relative to baseline
- Available P and exchangeable Ca, Mg and K all declined significantly ($p < 0.001$), consistent with strong nutrient uptake and leaching in high-rainfall volcanic soils
- Species-level ANOVA: *S. guianensis* exceeded *C. retusa* in organic matter; *C. retusa* and *S. guianensis* exceeded *C. cajan* in total nitrogen ($p < 0.05$)
- M. pruriens* and *C. retusa* plots retained the highest residual cation levels

Soil property	Baseline	Post-treatment	Change
pH (H ₂ O)	4.38 ± 0.00	4.69 ± 0.03	+7.1%***
Organic matter (g kg ⁻¹)	63.73 ± 0.00	69.00 ± 2.16	+10.7%*
Organic carbon (g kg ⁻¹)	36.39 ± 0.00	42.24 ± 1.83	+16.1%**
Total N (g kg ⁻¹)	1.76 ± 0.00	1.75 ± 0.06	−0.6% (ns)
Available P (mg kg ⁻¹)	26.97 ± 0.00	20.14 ± 0.81	−25.3%***
Exch. Ca (cmol kg ⁻¹)	5.17 ± 0.00	3.57 ± 0.17	−31.0%***
Exch. Mg (cmol kg ⁻¹)	1.84 ± 0.00	1.18 ± 0.06	−35.9%***
Exch. K (cmol kg ⁻¹)	1.46 ± 0.00	0.65 ± 0.04	−55.5%***

Table 1. Soil chemical properties before planting (baseline, $n = 3$) and after cover-crop termination (pooled post-treatment mean $\pm$ SE across five treatments, $n = 15$). Significance: paired baseline-vs-post-treatment test (* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$, ns = not significant); species-level Tukey’s HSD results for organic matter and total N are reported in the text above.

Highlights

- No single cover crop excelled at every function – species choice should match the target function
- M. pruriens* and *C. retusa* offer the most favourable trade-offs between biomass, weed control and soil quality
- Problem weeds (*Ageratum conyzoides*, *Eleusine indica*, *Cyperus rotundus*) persisted mainly in non-*Mucuna* plots

Conclusions and Outlook

- M. pruriens* and *C. retusa* emerged as the most multifunctional cover crops for the Mount Cameroon Region
- M. pruriens* combines the fastest canopy closure with by far the strongest weed suppression and favourable nutrient retention
- C. retusa* delivers the highest biomass and the second-best overall soil ranking
- We recommend prioritising *M. pruriens* and *C. retusa*, ideally in combination, for low-herbicide, climate-resilient rotations with banana, plantain or maize
- Targeted management of the post-season decline in available P and exchangeable cations (e.g. rock phosphate or organic amendments) is recommended given the strong P-fixing capacity of Mount Cameroon’s volcanic soils
- Multi-year, multi-site trials testing cover-crop mixtures and residual seedbank effects are needed before wider extension

Selected references: Angwafo & Danernyuy (2020) *Int. J. Eng. Sci. Technol.* 4(3):35–58 • Beyegue Djonko et al. (2022) *World J. Agric. Res.* 10(3):70–75 • Blanco-Canqui et al. (2015) *Agron. J.* 107(6):2449–2474 • Ndam et al. (2025) *Agric. Sci.* 16(2):290–306 • Phophi et al. (2017) *Sustain. Agric. Res.* 6(4):124–134 • Tening & Foba-Tendo (2013) *Agric. Biol. J. N. Am.* 4(3):166–174. Full reference list in the accompanying Tropentag 2026 full paper.

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