Effect of shade trees in cocoa agroforestry systems on water and light availability in dry seasons

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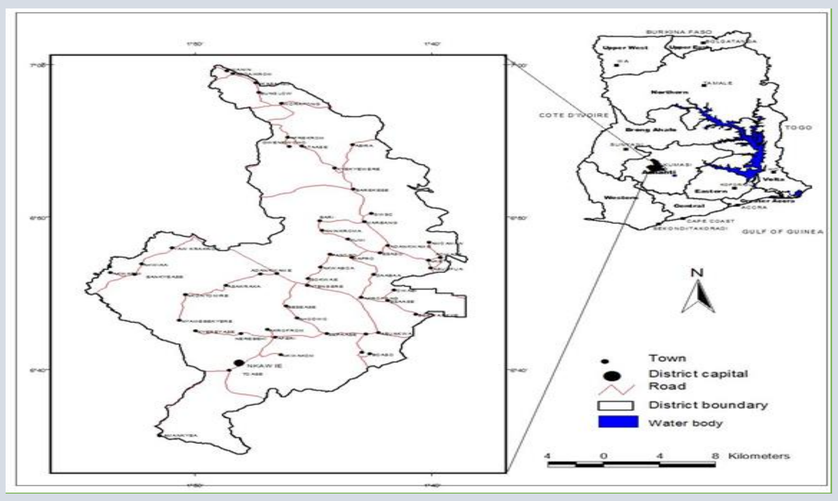
Introduction

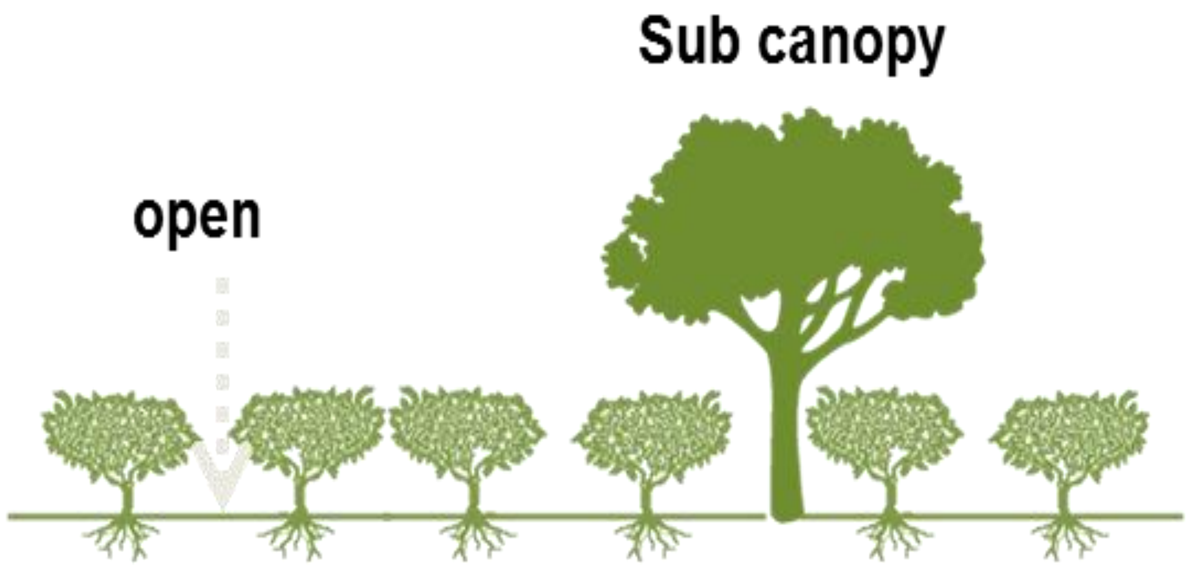
Even though the favourable effects of trees in cocoa systems are widely stated, information on the magnitude of these effects and how they ultimately translate into effects on yield is scarce and often controversial. More precisely, it is not yet evident to what magnitude trees influence different microclimatic factors in cocoa systems and how the magnitude of effects depends on the type of shade tree, thus which specific tree traits favour or hamper cocoa growth and yields, and to what extent. Species-specific studies support the importance of shade trees in cocoa systems for improved microclimate but comparisons of more species are required to give adequate tree trait based recommendations.

Materials and methods

- Moist semi-deciduous forest zone of Ghana



- **Assessed effect of shade trees on;**
  - ✓ Soil moisture content
  - ✓ Photosynthetic active radiation (PAR) availability
  - ✓ Potential pod yields of cocoa
- 7 different shade trees, 4 replicates each (28 trees) selected
- Effect ratio comparing sub-canopy effects to open sun effects was used to test for differences between the individual tree species

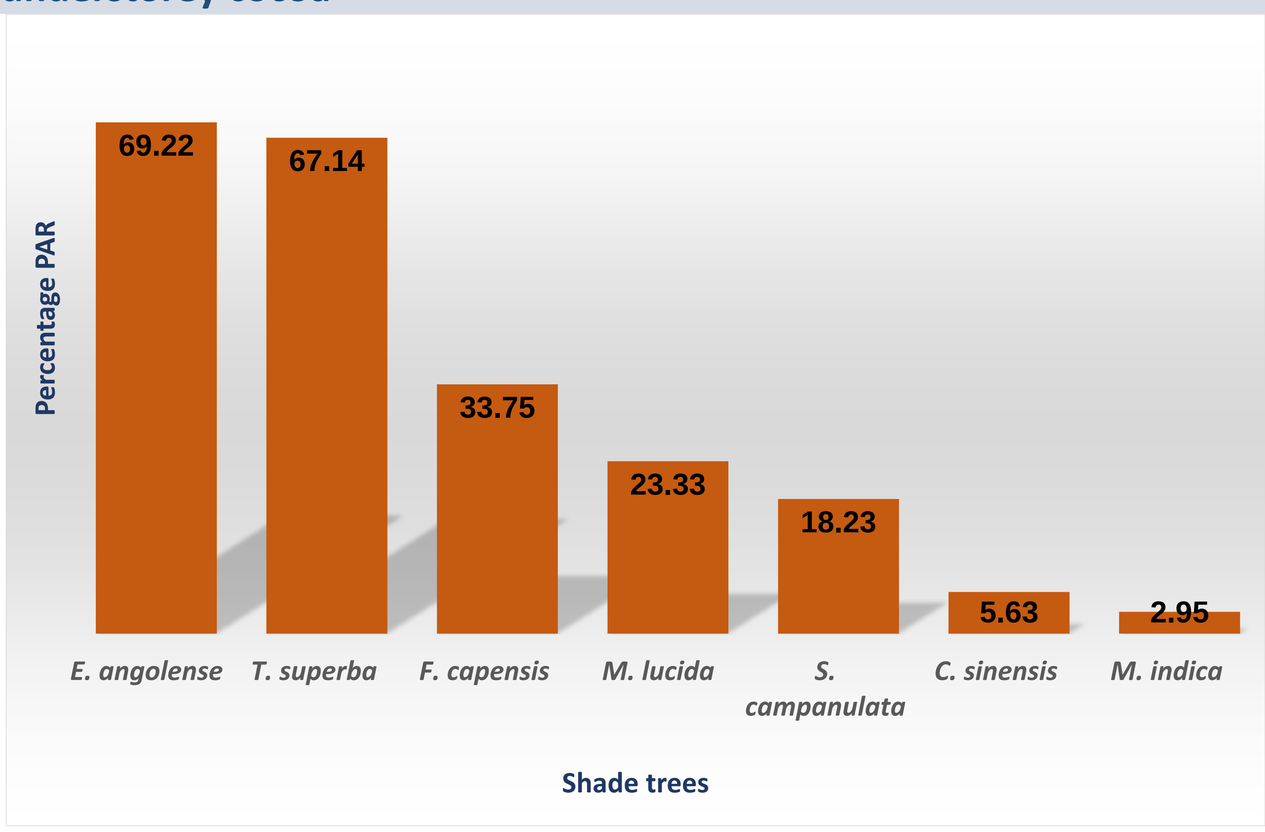


Results

Effect of shade trees on soil moisture content in cocoa agroforestry system

Tree species	% Soil Moisture Content		Moisture effect
	Sub-canopy	Open area	
M. lucida	8.06 ± 2.25	5.33 ± 1.23	0.19 ± 0.08[a]
S. campanulata	9.80 ± 2.38	7.56 ± 2.12	0.16 ± 0.08[a]
F. capensis	12.69 ± 2.29	9.24 ± 1.22	0.13 ± 0.06[a]
T. superba	10.79 ± 0.61	10.24 ± 0.95	0.03 ± 0.03[ab]
M. indica	6.43 ± 0.65	6.06 ± 0.30	0.02 ± 0.07[ab]
E. angolense	12.64 ± 2.47	13.47 ± 2.77	-0.03 ± 0.02[ab]
C. sinensis	4.75 ± 1.67	7.31 ± 1.77	-0.28 ± 0.12[b]

Effect of tree species on percentage PAR/ light transmitted to understorey cocoa



Effect of different tree species on potential pod yields of cocoa

Tree species	Number of pod yields		Pod yield effect
	Sub-canopy	Open area	
M. lucida	10.90 ± 1.80	4.50 ± 1.18	0.40 ± 0.17[a]
T. superba	8.23 ± 0.80	3.83 ± 1.42	0.40 ± 0.14[a]
E. angolense	15.05 ± 3.85	7.42 ± 3.42	0.34 ± 0.11[a]
S. campanulata	15.87 ± 1.47	11.67 ± 1.42	0.15 ± 0.10[ab]
F. capensis	5.60 ± 0.60	7.42 ± 3.42	-0.03 ± 0.22[ab]
C. sinensis	6.93 ± 3.70	11.25 ± 5.64	-0.26 ± 0.02[ab]
M. indica	3.58 ± 1.68	10.04 ± 1.63	-0.55 ± 0.15[b]

Conclusions

- Soil moisture content in sub-canopies of *M. lucida, S. campanulata* and *F. capensis* significantly higher than under *C. sinensis* in the dry seasons.
- *E. angolense* and *T. superba* transmit high PAR to sub-canopy cocoa during dry seasons.
- Potential yields of cocoa in the sub-canopies of *M. lucida*, *T. superba* and *E. angolense* are high while yields under *C. sinensis* and *M. indica* are low.
- *M. lucida, S. campanulata, E. angolense* and *T. superba* in cocoa systems potentially ensure favourable microclimate in the sub-canopy, especially during the dry seasons, which could translate into higher yields.