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"Global food security and food safety:
The role of universities"

The Effects of Soil Compaction on the Growth of Oil Palm (*Elaeis guineensis* Jacq.) Seedlings

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Context: Oil palm and soil compaction

- Oil palm is a perennial crop planted in cycles of 25 years in average
- Most productive oil crop with oil yields of 4-8 t/year/ha possible
- Labour intensive crop with one worker per 5-10 hectares
- Mechanisation of field operations to increase labour productivity and maintain competitiveness
- Risk of soil compaction associated with use of heavy machinery
- Repeated passages can increase soil bulk density to 1.8 g/cm^3 along the tracks (10% of surface area)
- What effect does soil compaction have on oil palm growth and development ?

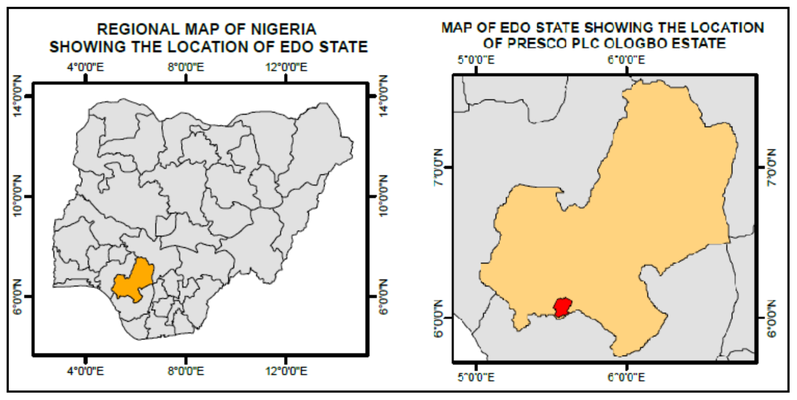

Figure 1: Map of Nigeria and Edo State showing the location of the Presco plc Ologbo estate where the trial was located

Material and methods

- Controlled compaction levels in tube pots
- Homogeneous seedlings transplanted from pre-nursery in pots
- Experimental trial with 7 seedlings per plot and 6 replicates
- 4 Treatments: soil densities of 1.5 g/cm^3 , 1.7 g/cm^3 , 1.9 g/cm^3 + Control (seedlings is standard polybags and no soil compaction)
- Measurements of growth variables every 2 weeks for 7 months
- Measurements of dry biomass and primary root length after 7 months
- Statistical analysis by ANOVA and comparison with Tukey test for Honest Significant Difference at 5%.

Results

Figure 2 : Packed pipes prior to soil filling and compaction (top left), Growth observation of seedlings during the early trial stage (bottom left) and exposed soil cilinder with roots ready for biomass data collection (right)

Table 1: Average dry weight of the seedlings and total primary root length at the end of the 7months pot experiment (Comparison based on Tukey Test at 5%)

Treatment	Shoot Dry Weight (g)	Primary Root Dry Weight (g)	Fine Root Dry Weight (g)	Total Dry Weight (g)	Primary Root Length (cm)
Control	58.5^a	6.2^a	9.5^a	107.9^a	390.5^a
1.5	63.7^a	4.6^b	5.3^b	99.3^a	337.3^a
1.7	46.1^a	3.2^{bc}	4.0^b	67.6^b	246.0^b
1.9	22.7^b	2.3^c	1.5^c	33.6^c	151.3^c
Pr>F	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001

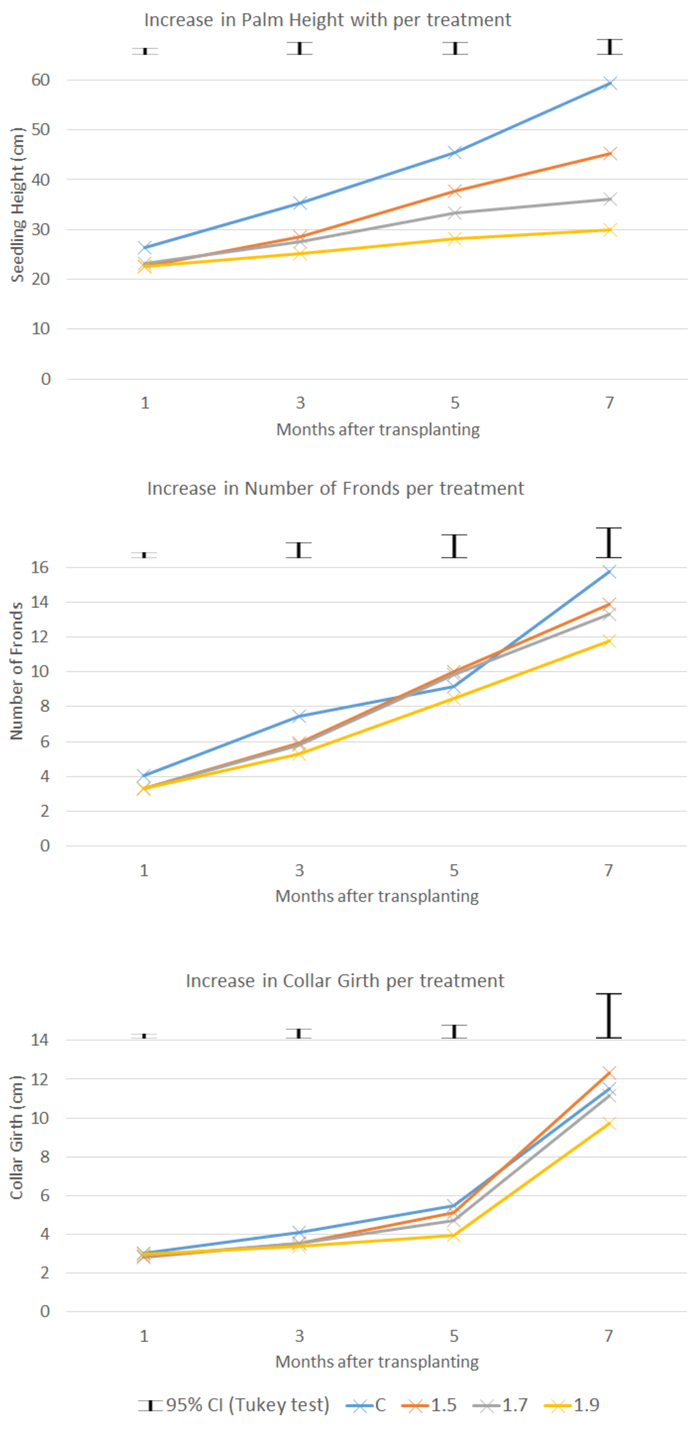

Figure 2 : Mean values of growth parameters palm height (A), number of fronds (B) and collar girth (C) at 1, 3, 5 and 7 months after planting with confidence interval based on Tukey test at 5%

Conclusions

- Soil compaction significantly affects the growth of oil palm seedlings under the controlled nursery pot experiment.
- Biomass production and primary root length decrease with increasing soil bulk density even with minimal compaction.
- Similar limiting effects on root development can be expected in the field when compaction occurs.
- Rational use of machinery in plantation to restrict detrimenal effects from soil compaction.
- Further investigations in-situ needed to evaluate the risk in the field and the effect on production as well as remediation possibilities.

References

Ariyoh, L.E. (2018) Effect of soil compaction on growth of oil palm (Elaeis guineensis Jacq.) seedlings. Unpublished master's thesis, University of Benin, Benin City, Edo State, Nigeria

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