The Effect of Soil and Foliar Zn & Mn Applications on the Uptake of Cd Levels in Cacao Grown on Cd-Rich Soils

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AGENDA

• Cadmium (Cd) & Cacao

• Mitigation Strategies: Cd

• Methodology: Foliar Application: Zinc (Zn) & Manganese (Mn)

• Results

• Summary

• Conclusion/Recommendation
Cadmium & Cacao

Food Safety Limits
CADMIUM IN COCOA
CADMIUM MITIGATION STRATEGIES: CACAO

Soil amelioration

Genetic

Post-harvest

Credit: Paula Flynn, 2022
Credit: canva, 2022
Credit: The Chocolate Journalist, 2016
LITERATURE REVIEW: The effect of soil & foliar application of Zn & Mn on Cd uptake in rice & wheat
LITERATURE REVIEW: Cd/Mn/Zn Relationships in Cacao

Lewis et al., 2021

2022 International Symposium on Cocoa Research (ISCR), Montpellier, France
Soil & Foliar Application of Zn & Mn to Reduce Cd Uptake in Cacao?
METHODOLOGY

Greenhouse Trial: Soil & Foliar application of Zn & Mn

Low Zn/Mn Cd-rich soil

Single variety rooted cacao cuttings

Completely randomized block design
METHODOLOGY

Greenhouse Trial: Soil & Foliar application of Zn & Mn

Zn-EDTA & Mn-EDTA

Rate: 10-15 kg/ha
    1-2 tbsp/gallon

• Application done with a spray can
• Leaf samples (interflush 2) taken every 2 months for an 8 month period.
RESULTS: GREENHOUSE TRIAL

Fig 1. Effect of Mn & Zn soil applications on Cd uptake in cacao leaves

Fig 2. Effect of Mn & Zn foliar applications on Cd uptake in cacao leaves
METHODOLOGY

Field Trial: Foliar application of Zn & Mn

Cacao farm with low Zn/Mn Cd rich soil

14 year old cross-grafted TSH varieties

Completely randomized block design with guard trees
METHODOLOGY

**Field Trial**: Foliar application of Zn & Mn

Zn-EDTA & Mn-EDTA

Rate: 10-15 kg/ha
1-2 tbsp/gallon

- Application done with a mist blower
- Leaf samples (interflush 2) taken every month for a 5 month period.
RESULTS: FIELD TRIAL

**Fig 3.** Effect of Mn foliar application on Cd uptake in cacao leaves

**Fig 4.** Effect of Zn foliar application on Cd uptake in cacao leaves
SUMMARY

- **Greenhouse soil and foliar applications of both Mn & Zn** reduced Cd uptake in cacao leaves compared to control - *Zn soil treatment observed to be more effective*

- **Field Zn foliar application** reduced Cd levels in cacao leaves with a noticeable decrease after 1 month of application - *the effectiveness diminished over time.*

- **Field Mn foliar application** - no immediate effect, however a difference in Cd uptake compared to control after month 3.

- **Field soil applications of Mn and Zn** - based on initial greenhouse studies, may be more effective as a treatment to reduce Cd uptake in cacao - *further studies required*
• Zn & Mn soil and foliar application is an effective approach to reduce Cd levels in cacao leaf tissue - may offer an alternative approach to farmers

• Rate/method of application should be optimized - in order to improve effectiveness of treatment

• Cacao bean Cd levels should also be evaluated
ACKNOWLEDGMENTS
THANK YOU FOR YOUR ATTENTION