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Evaluation of Activane defense inductor incorporated inside a fungicide rotation against Pseudocercospora fijiensis in banana.

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INTRODUCTION. Inducers of defense in banana plants (*Musa acuminata* AAA) against *Pseudocercospora fijiensis*, the causal agent of black Sigatoka, function by activating hormonal and defense responses. Salicylic acid (SA) and jasmonic acid (JA) are key hormones that regulate the expression of defense-related genes, leading to the production of antimicrobial proteins and specialized compounds that inhibit pathogen growth. While SA is particularly effective against biotrophic pathogens, JA also plays a significant role by stimulating defense pathways against *P. fijiensis* (Terrero, 2020).

In addition to hormonal activation, these inducers promote the synthesis of hydrolytic enzymes such as glucanases and chitinases, which break down the pathogen's cell walls. Based on the background of defense inducers, the evaluation of the product Activane was deemed necessary. Activane, with its composition COS (Chito-oligosaccharides) 500 g L^{-1}, could potentially serve as a valuable tool for preventing *Pseudocercospora fijiensis*.

MATERIALS AND METHODS. The trial was carried out in Ecuador, Santo Domingo de los Tsáchilas province, La Concordia city, Plan Piloto parish in the BanaField – La Concordia station, during the season from 2024-may to 2024-jul (rainy season). The plant material used was meristematic banana plants, Williams variety. The study factor was the application of fungicide products at the phenological phase BBCH 1 (Leaf development) at 89 days after transplant; the trial was structured by 9 treatments (table 1) and 4 replicates, in a Randomized Complete Block (RCB) design, with 10 plants for each plot. The Biological Warning method for evaluation was employed, quantified as an absolute value in Evolutive Stage (ES) units. The second method utilized was the Stover method modified by Gauhl. This method is expressed as an absolute value in Weighted Average of Infection (WAI) units.

Table 1. Treatments under study of foliar applications.

Treatments	0 daa	7 daa	14 daa	21 daa	28 daa	35 daa	42 daa
T1	Control	Control	Control	Control	Control	Control	Control
T2	Paraffinic oil	Mancozeb	Paraffinic oil	Mancozeb	Paraffinic oil	Mancozeb	Paraffinic oil
T3	ACTIVANE (0.5 kg ha^{-1})	ACTIVANE (0.5 kg ha^{-1})	ACTIVANE (0.5 kg ha^{-1})	ACTIVANE (0.5 kg ha^{-1})	ACTIVANE (0.5 kg ha^{-1})	ACTIVANE (0.5 kg ha^{-1})	ACTIVANE (0.5 kg ha^{-1})
T4	ACTIVANE (0.50 kg ha^{-1})	Mancozeb	ACTIVANE (0.50 kg ha^{-1})	Mancozeb	ACTIVANE (0.50 kg ha^{-1})	Mancozeb	ACTIVANE (0.50 kg ha^{-1})
T5	ACTIVANE (0.75 kg ha^{-1})	Mancozeb	ACTIVANE (0.75 kg ha^{-1})	Mancozeb	ACTIVANE (0.75 kg ha^{-1})	Mancozeb	ACTIVANE (0.75 kg ha^{-1})
T6	TIVIANT PRIME (Isotianil)	Mancozeb	TIVIANT PRIME (Isotianil)	Mancozeb	TIVIANT PRIME (Isotianil)	Mancozeb	TIVIANT PRIME (Isotianil)
T7	Reflect (Isopyrazam)	Mancozeb	Reflect (Isopyrazam)	Mancozeb	Reflect (Isopyrazam)	Mancozeb	Reflect (Isopyrazam)
T8	Reflect (Isopyrazam)	ACTIVANE (0.5 kg ha^{-1})	Reflect (Isopyrazam)	ACTIVANE (0.5 kg ha^{-1})	Reflect (Isopyrazam)	ACTIVANE (0.5 kg ha^{-1})	Reflect (Isopyrazam)
T9	ACTIVANE (0.5 kg ha^{-1}) + Adjuvant	ACTIVANE (0.5 kg ha^{-1}) + Adjuvant	ACTIVANE (0.5 kg ha^{-1}) + Adjuvant	ACTIVANE (0.5 kg ha^{-1}) + Adjuvant	ACTIVANE (0.5 kg ha^{-1}) + Adjuvant	ACTIVANE (0.5 kg ha^{-1}) + Adjuvant	ACTIVANE (0.5 kg ha^{-1}) + Adjuvant

RESULTS AND DISCUSSION. Dynamic of disease with Stover modified by Gauhl method. The results (Figure 1) indicate that Isopyrazam 0.6 L ha^{-1} in rotation with Mancozeb (T7) and Isopyrazam 0.6 L ha^{-1} in rotation with ACTIVANE 0.5 kg ha^{-1} (T8) were the most effective in reducing the SAUDPC WAI for Black Sigatoka. These treatments achieved the lowest SAUDPC WAI values, suggesting superior control over the disease severity throughout the evaluation period. In contrast, treatments with ACTIVANE and Mancozeb in rotation (T4 and T5), while providing some level of control, were less effective than T7 and T8. This indicates that although these treatments reduced disease severity, they did not achieve the same level of efficacy as the top-performing treatments.

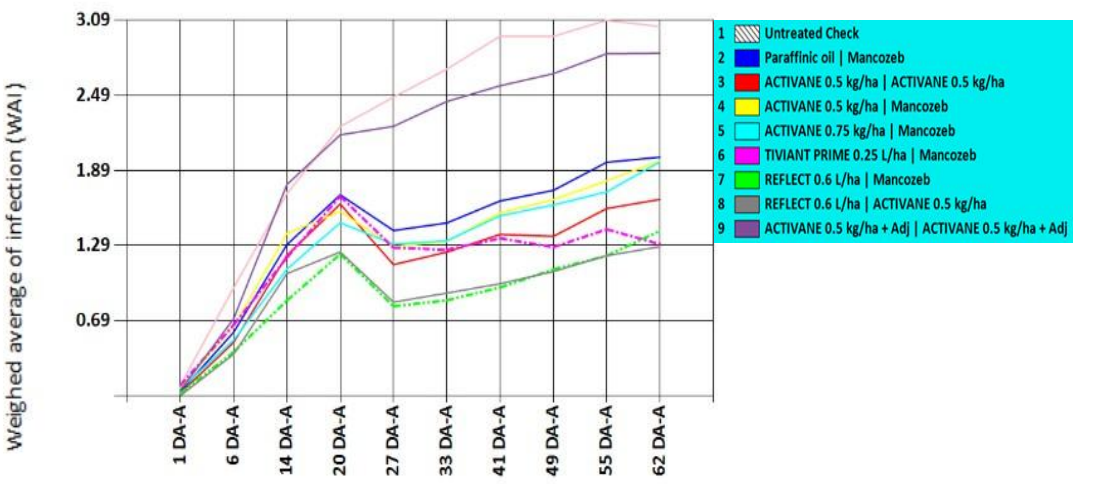

Figure 1. Dynamics of disease progression with the Stover modified by Gauhl method, expressed as Weighed Average of infection (WAI) during the trial.

Abbott´s Efficacy. Global efficacy was assessed using SAUDPC values derived from the average units of the Biological Warning Method (EE) and the Weighted Average of Infection (WAI) variables (Figure 2). The highest efficacy values were observed in treatments involving rotation with Isopyrazam (Isopyrazam), which demonstrated a significant margin due to its systemic nature. Specifically, treatments T7 (Isopyrazam | Mancozeb) and T8 (Isopyrazam | Activane) achieved efficacies of 66.86% and 63.00%, respectively. In a statistically distinct level, treatments T3 through T6 exhibited comparable efficacy values, clearly outperforming the base comparison treatment T2 (Paraffinic Oil | Mancozeb). **This indicates that the inclusion of a fungicide in the rotation with paraffinic oil improved control levels**. No significant differences were found between treatments T3 and T4, indicating that the rotation of Activane | Mancozeb is equivalent to Activane | Activane.

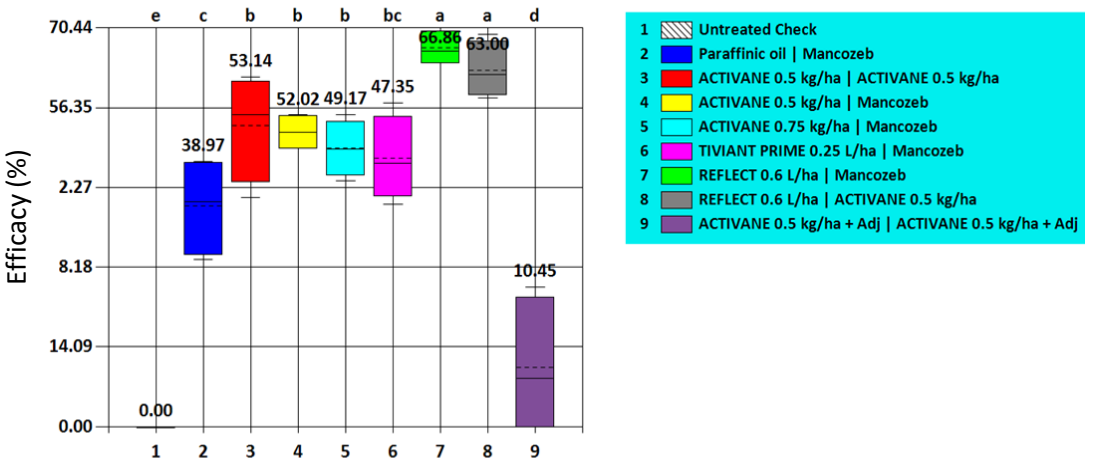

Figure 2. Abbott´s global efficacy with SAUDPC units from average units from Biological Warning Method (EE) and Weighed Average of infection (WAI) variables.

CONCLUSIONS. No phytotoxicity symptoms were observed across any of the treatments evaluated.

Treatments 7 (Isopyrazam 0.6 L ha^{-1} | Mancozeb) and 8 (Isopyrazam 0.6 L ha^{-1} | ACTIVANE 0.5 kg ha^{-1}) consistently exhibited the highest levels of disease control throughout the trial, as evidenced by the lowest disease severity (ES) values at all evaluation points, including 14, 27, 41, and 49 days after application. These treatments demonstrated significant efficacy in suppressing disease progression compared to the untreated control and other treatments. Treatments T3 through T6, which included various combinations of ACTIVANE and Mancozeb, also showed considerable efficacy, but did not achieve the superior results observed with Treatments 7 and 8. Notably, Treatment T2 (Paraffinic Oil | Mancozeb) provided better disease control compared to the adjuvant-based treatments, although it was less effective than Treatments 7 and 8.

BIBLIOGRAPHY.
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