PHYTOSANITARY SURVEY IN CITRUS PRODUCTION UNITS IN THE MUNICIPALITIES OF APORÁ, INHAMBUPE, AND SÁTIRO DIAS.

Abstract

Citrus cultivation is an agricultural activity of great socioeconomic relevance in the state of Bahia, particularly within the Litoral Norte and Agreste Baiano (LNAB) territories. This study aimed to conduct a phytosanitary survey across 137 Citrus Production Units (PUs) located in the municipalities of Aporá, Inhambupe, and Sátiro Dias to identify and characterize the main pests present in the region. The adopted methodology relied on technical protocols for phytosanitary monitoring, featuring systematic field inspections of plants. The results demonstrated that the predominant crops are sweet orange, Tahiti acid lime, and mandarin, with significant participation from family farming. Non-quarantine pests were identifiedsuch as snow scale, citrus leafminer, citrus blackfly, citrus orthezia, aphid, anthracnose, greasy spot, and gummosisshowing frequency variations among municipalities. Regulated quarantine pests, such as citrus canker and Greening (HLB), were not detected, underscoring the importance of continuous monitoring to maintain Bahia's phytosanitary status. The findings contribute to planning integrated pest management strategies and strengthening regional citrus farming.

Keywords: Family farming; Integrated pest management; Phytosanitary monitoring; Plant health

Introduction: -

Contemporary commercial fruit production demands a high degree of professionalization, as access to international markets is contingent upon compliance with a complex regulatory framework established by importing nations, which frequently translates into non tariff barriers. According to FAO (2024), approximately 933 million metric tons of fruit were produced globally in 2022. China leads as the largest global producer, with a strong concentration in crops such as apple, citrus, melon, pear, and watermelon; India holds the second position, with notable relevance in banana, mango, sweet orange, and papaya.

In Brazil, citrus farming plays a strategic role, driven not only by foreign exchange generation but also by high production concentration in sweet orange crops. The sector exhibits strong spatial concentration: the state of São Paulo accounts for approximately 63% of the cultivated area and 77% of national sweet orange production (BNB, 2024). In Bahia, citrus cultivation is diversified, with a predominance of the ‘Pera’ sweet orange cultivar, alongside 'Tahiti' lime and ‘Ponkan’ mandarin crops.

The Bahian sector is characterized by the coexistence of smallholders operating at lower technological levels and large, highly technified enterprises oriented toward export markets. Production is primarily distributed across the Litoral Norte and Recôncavo regions, with notable emphasis on Juazeiro a major production hub for Tahiti acid lime solidifying Bahia as the largest citrus producer in the North and Northeast regions of Brazil (IBGE, 2023). It is estimated that Bahian citrus farming occupies approximately 70,000 hectares, encompassing sweet orange, mandarin, sweet lime, and Tahiti acid lime destined for both the fresh market and the

concentrated juice industry. Remarkably, around 70% of production is conducted by family farmers, although the largest land areas remain under the domain of medium- and large-scale growers (GIRARDI et al., 2015; ADAB, 2024).

Brazilian citrus production faces significant challenges related to pest occurrence, which has intensified pesticide application, increasing costs and compromising yield. According to the Ministry of Agriculture and Livestock (MAPA, 2018), in alignment with the International Plant Protection Convention (IPPC), the term "pest" encompasses not only insects and animals, but also plant pathogens capable of causing damage to plants and plant products. In this context, plant diseases are likewise classified as pests due to the economic losses they inflict. Official classification distinguishes between Quarantine Pests which are absent or restricted to specific areas under official control but pose potential economic risk and Regulated Non-Quarantine Pests, which are already distributed within the national territory but require strict oversight in plant propagating material (MAPA, 2006).

Given this scenario, this study aims not only to conduct a phytosanitary survey across citrus production units in the municipalities of Aporá, Inhambupe, and Sátiro Dias, but also to assist in establishing effective strategies for the prevention, control, and potential eradication of pests that attack or threaten regional citrus farming.

MATERIALS AND METHODS

The survey was conducted across 137 Production Units (PUs) located in the municipalities of Aporá, Inhambupe, and Sátiro Dias, which belong to Identity Territory 18 – Litoral Norte and Agreste Baiano (Figure 1).

Field activities were carried out between May and August 2025, a period selected as it coincides with the peak of production intensity and pest occurrence in the orchards, thereby allowing for a more representative characterization of the regional phytosanitary status.

Figure 1: Map of Identity Territory 18 – Litoral Norte e Agreste Baiano, showing the municipalities covered by the study. **Source:** BAHIA. State Secretariat of Culture of Bahia, adapted.

2.1 Crop characteristics of citrus orchards in the Litoral Norte and Agreste Baiano

To characterize citrus production in the Litoral Norte and Agreste Baiano (LNAB) region, secondary data were obtained from the Municipal Agricultural Production Permanent Crops database, made available by the Brazilian Institute of Geography and Statistics (IBGE, 2024). The choice of this database is justified by its scope, reliability, and widespread use in regional agricultural and economic studies, enabling consistent and comparable analyses across different municipalities.

Based on the collected information, three fundamental variables were analyzed: harvested area, production quantity, and average yield (t/ha) for the main citrus species cultivated in the region, with emphasis on sweet orange, Tahiti acid lime, and mandarin. Data were organized by municipality, allowing for the identification of production patterns, performance differences, and the synthesis of relevant observations to understand citrus dynamics in the LNAB.

2.2 Phytosanitary survey

The phytosanitary survey was conducted based on methodologies proposed in reference manuals from Embrapa and partner institutions, including *Identificação e Monitoramento de Pragas e Doenças Regulamentadas, Quarentenárias e Seus Inimigos Naturais na Cultura dos Citros no Amazonas* (Nascimento et al., 2006; Santos Filho et al., 2015) and *Practical Manual for Monitoring and Pest Control in Tahiti Acid Lime*(Embrapa, 2009). The methodologies were adapted to the edaphoclimatic conditions of the Litoral Norte and Agreste Baiano, ensuring standardization of observations and reliability of results.

Evaluations were conducted across Citrus Production Units (PUs), with two visits per property scheduled between 7:00 AM–11:00 AM and 3:00 PM–5:00 PM. These time intervals are recommended by Embrapa for field inspections due to higher insect activity and improved visibility of plant structures. The inspection route followed a zig-zag pattern, entering and exiting on opposite sides of the plot and returning in the reverse direction to ensure representative sampling (Figure 2). In each plot, 20 plants were randomly selected in accordance with technical recommendations, allowing for systematic observation of pest symptoms and signs (Figure 3). Data were recorded in a pest monitoring datasheet (Figure 4).

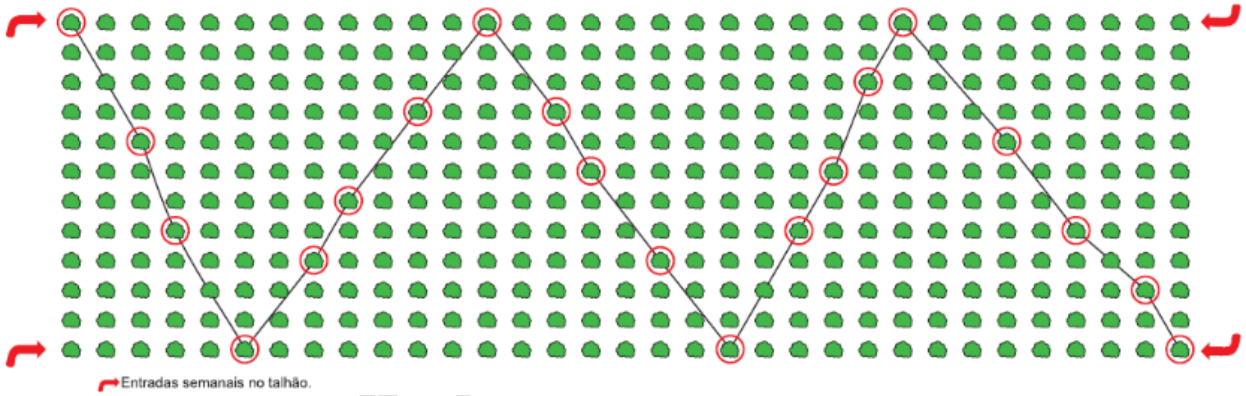

Figure 2: Pest monitoring procedures and route layout.**Source:** NASCIMENTO et al., 2006 and SANTOS FILHO et al., 2015

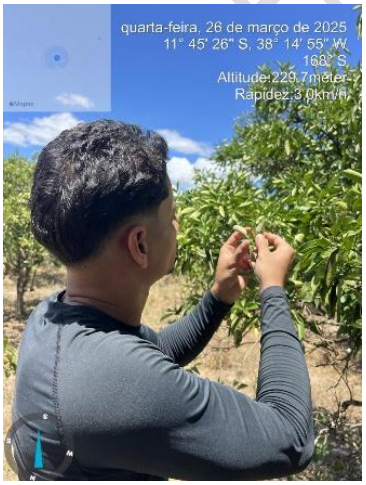

Figure 2: Pest monitoring. **Source:** JESUS, 2025

FICHA DE DIAGNÓSTICO FITOSSANITÁRIO

1. Identificação da Unidade de Produção averiguada

Município:	Comunidade:	
Cultura:	Data:	

2. Monitoramento fitossanitário - pragas identificadas

			NÚMERO DE PLANTAS INSPECIONADAS (adentrando o pomar - caminhamento em zigue-zague)																			
2.1 ÁCAROS	NÍVEL DE INFESTAÇÃO	Nº DE FRUTOS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
ÁCARO DA FALSA FERRUGEM	2 ÁC/cm2	FRUTO 1																				
		FRUTO 2																				
		FRUTO 3																				
ÁCARO BRANCO	2 ÁC/cm2	FRUTO 1																				
		FRUTO 2																				
		FRUTO 3																				
ÁCARO DA LEPROSE	2 ÁC/cm2	FRUTO 1																				
		FRUTO 2																				
		FRUTO 3																				
2.2 BACTÉRIAS			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
CVC - "amarelinho"																						
Cancro Cítrico																						
HLB dos Citros																						
2.3 COCHONILHAS			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Escama Farinha																						
Parlatória																						
Ortézia																						
2.4 DISTÚRBIO FISIOLÓGICO			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Podridão Estilar																						
2.5 FUNGOS			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Antracnose (Estrelinha)																						
Mancha Graxa dos Citros																						
Gomose																						
Pinta Preta																						
2.6 INSETOS E PROMOTORES DE DANOS MECÂNICOS			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Mosca-negra-dos -citros																						
Larva Minadora																						
Arapuá																						
Formigas																						
Broca do tronco																						
2.7 INSETOS VETORES			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Cigarrinhas																						
Pulgões																						
Psilídio (*Diaphorina citri*)																						
2.8 VÍRUS E VIRÓIDES			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Leprose dos Citros																						
Exocorte																						

Figure 3: Pest monitoring datasheet. **Source:** JESUS, 2025.

For mites and insects, fruits, leaves, and branches were inspected to detect characteristic symptoms such as silvering, rusting, leaf mines, and the presence of scale insects or fruit flies.

For bacterial and viral diseases, such as Citrus Canker (*Xanthomonas citri* subsp. *citri*) and Huanglongbing (HLB) (*Candidatus* Liberibacter spp.), typical symptoms were observed on leaves and fruits, including corky lesions, blotchy mottle chlorosis, and yellowing shoots. Inspections followed visual sampling protocols in accordance with guidelines from ADAB and Embrapa.

Fungal diseases were monitored through the inspection of flowers, fruits, and trunks, with special focus on citrus postbloom fruit drop (*Colletotrichum* spp.), gummosis (*Phytophthora* spp.), and scab (*Elsinoë* spp.). Evaluated symptoms included necrotic spots, flower abortion, gum exudation, and raised lesions on fruits.

3. RESULTS AND DISCUSSION

3.1 Crop characteristics of citrus orchards in the Litoral Norte and Agreste Baiano

Data released by the Brazilian Institute of Geography and Statistics (IBGE, 2024) demonstrate that, in the Litoral Norte and Agreste Baiano (LNAB), citrus farming maintains a prominent role among regional agricultural activities, establishing itself as one of the primary sources of agricultural income. Sweet orange remains the predominant crop among citrus species, followed by lemon, including the Tahiti acid lime cultivar, and mandarin (Table 1).

This predominance reflects both the adaptation of these species to local edaphoclimatic conditions and a production tradition consolidated over recent decades. Furthermore, the distribution of cultivated areas highlights the diversified nature of regional citrus farming, which combines family-based production systems with medium-scale enterprises oriented toward supplying local and regional markets.

Table 1: Key citrus production results in Identity Territory 18 – LNAB

Municipalities	Harvested area (ha)			Quantity produced (ton)			Average yield (Kg.ha^{-1})		
	Orange	Tahiti acid lime	Tangerine	Orange	Tahiti acid lime	Tangerine	Orange	Tahiti acid lime	Tangerine
Bahia	**48.924**	**6.884**	**1.521**	**14.765**	**4.404**	**1.224**	**604.534**	**87.314**	**15.734**
Acajutiba	1.111	3	-	10.199	34	-	9.180	11.333	-
Alagoinhas	918	10	10	21.120	153	250	23.007	15.300	25.000
Aporá	475	-	-	5.140	-	-	10.821	-	-
Araçás	69	-	-	947	-	-	13.725	-	-
Aramari	69	-	-	1.257	-	-	18.217	-	-
Cardeal da Silva	35	-	-	520	-	-	14.857	-	-
Catu	44	21	-	323	216	-	7.341	10.286	-

Conde	371	-	-	4.325	-	-	11.658	-	-
Crisópolis	190	-	-	1.347	-	-	7.089	-	-
Entre Rios	714	20	-	10.924	218	-	15.300	10.900	-
Esplanada	4.120	20	-	45.629	111	-	11.075	5.550	-
Inhambupe	9.000	433	45	114.048	7616	441	12.672	17.589	9.800
Itanagra	-	-	-	-	-	-	-	-	-
Itapicuru	3.920	-	-	41.282	-	-	10.531	-	-
Jandaíra	1.224	-	-	11.236	-	-	9.180	-	-
Olindina	21	-	-	23	-	-	1.095	-	-
Ouriçangas	10	-	-	52	-	-	5.200	-	-
Pedrão	5	-	-	47	-	-	9.400	-	-
Rio Real	16.830	194	51	241.443	2517	607	14.346	12.974	11.902
Sátiro Dias	143	561	4	2.042	16421	41	14.280	29.271	10.250

Source: IBGE – Agricultural Production in Bahia, 2024. Accessed on October 22, 2025; adapted

This analysis revealed that, although sweet orange represents the largest total cultivated area, its relative share in the LNAB region is smaller when compared to lemon and mandarin, suggesting a regional production reconfiguration. This dynamic may be associated with both the pursuit of specific market niches and the higher economic resilience of alternative species capable of meeting diverse consumer profiles and mitigating production concentration risks.

2.2 Phytosanitary survey

Data obtained from the phytosanitary survey conducted across 137 Citrus Production Units (PUs) revealed the occurrence of the following pests: citrus snow scale (*Unaspis citri*), citrus leafminer (*Phyllocnistis citrella*), citrus blackfly (*Aleurocanthus woglumi*), woolly whitefly (*Aleurothrixus floccosus*), citrus orthezia (*Praelongorthezia praelonga*), black citrus aphid

(*Toxoptera citricidus*), anthracnose or postbloom fruit drop (*Colletotrichum* spp.), greasy spot (*Zasmidium citri-griseum* / *Mycosphaerella citri*), and gummosis (*Phytophthora* spp.). All were recorded across the three municipalities in the study area, albeit at varying levels of occurrence (Figures 2, 3, and 4), and were classified as Non-Quarantine Pests.

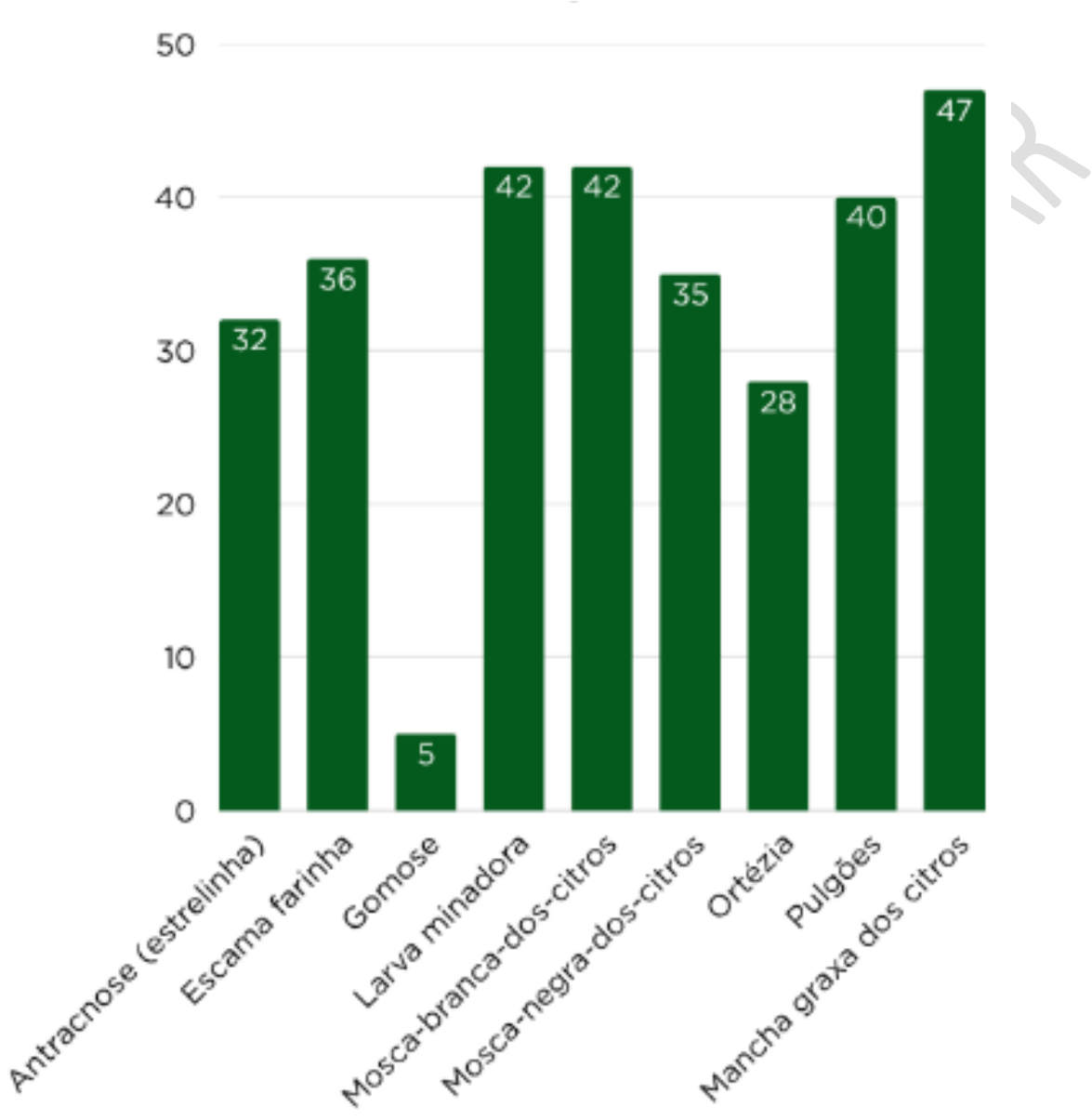

Figure 2: Main pests surveyed in Aporá. **Source:** JESUS, 2025.

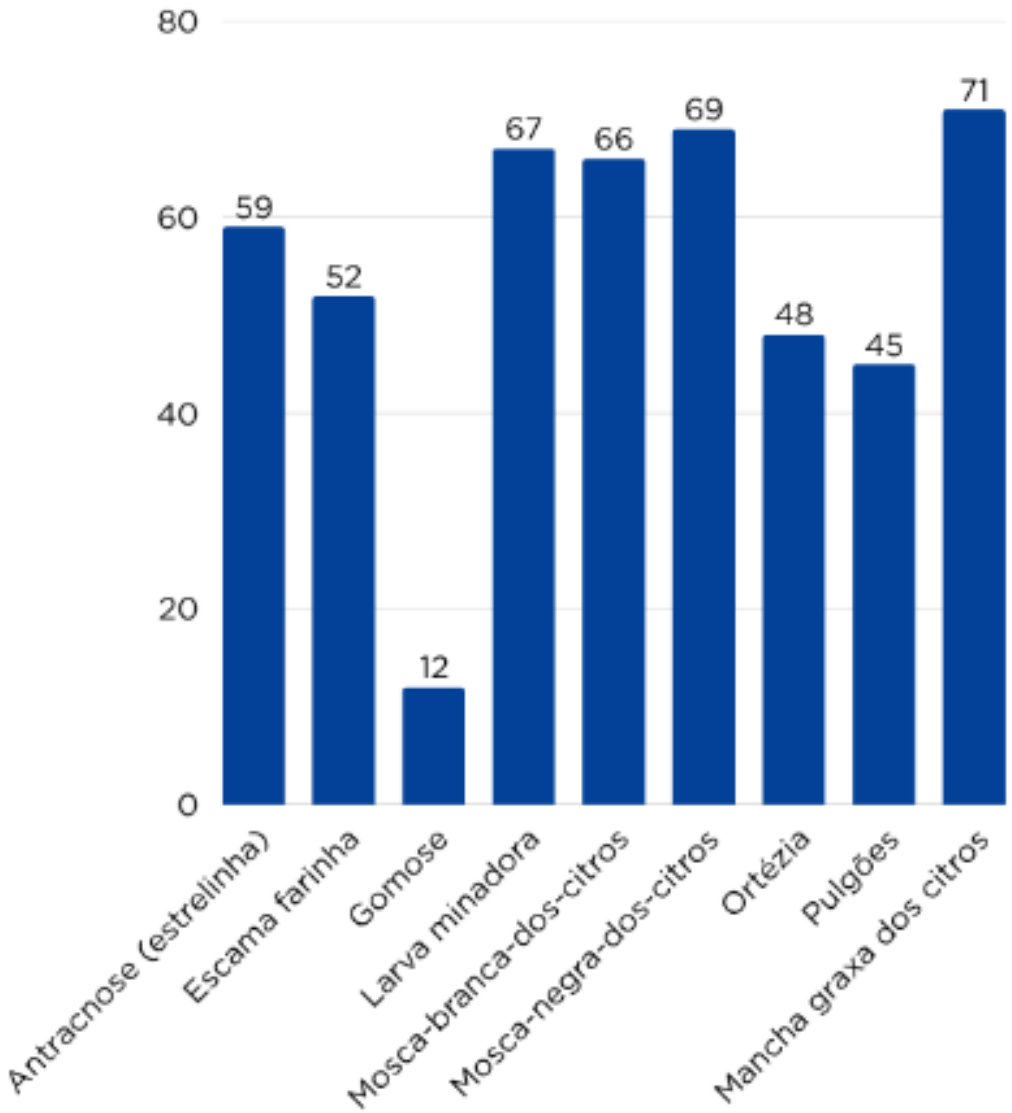

Figure 5: Main pests surveyed in Inhambupe. Source: JESUS, 2025.

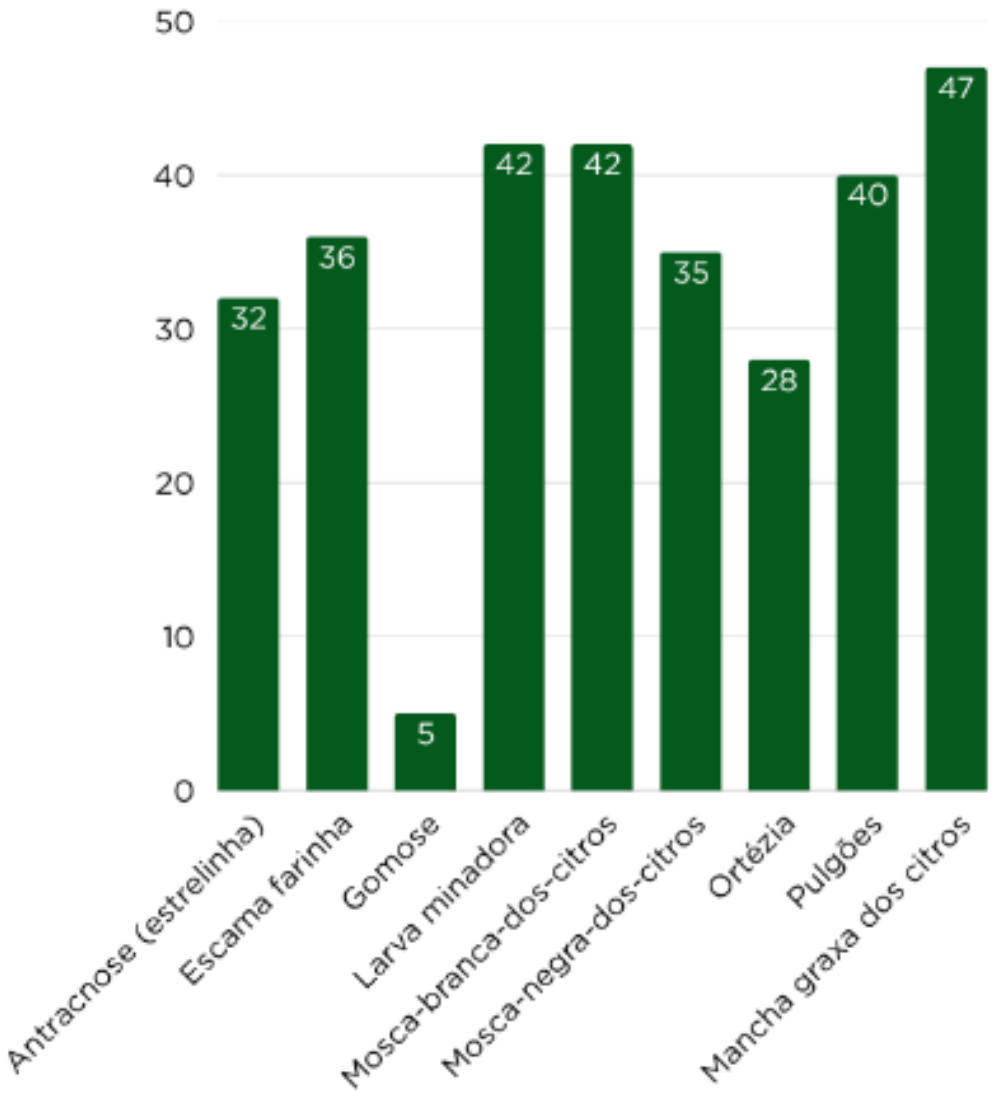

Figure 6: Main pests surveyed in Sátiro Dias. Source:JESUS, 2025.

The presence of these pests confirms findings from previous studies on Brazilian citrus farming, which highlight the citrus snow scale and citrus orthezia as economically significant scale insects capable of reducing plant vigor and predisposing orchards to secondary infections (Fundecitrus, 2025; Rossetti, 2001). The citrus leafminer, in turn, is considered a key pest in tropical regions due to its widespread distribution and the direct damage inflicted on young leaves, which impairs vegetative development (Chagas et al., 2012).

The occurrence of citrus blackfly and woolly whitefly underscores concerns regarding sap-sucking pests. Beyond causing direct damage through sap feeding, these pests promote sooty mold growth (*Capnodium citri*), reducing photosynthetic capacity and depreciating the commercial value of the fruit (Gabriel et al., 2020). The black citrus aphid (*T. citricidus*)

warrants special attention as the vector for citrus tristeza virus (CTV), one of the most destructive diseases affecting global citrus production (Müller et al., 2019).

Among the recorded diseases, anthracnose (*Colletotrichum* spp.) and greasy spot (*Zasmidium citri-griseum* / *Mycosphaerella citri*) are widely documented as causes of both qualitative and quantitative yield losses, affecting flowers, leaves, and fruits, and compromising both productivity and commercial appearance (Batuman et al., 2020). Gummosis (*Phytophthora* spp.) is regarded as one of the most severe citrus diseases due to its high soil dissemination capacity and direct impact on root systems and trunks, leading to rapid tree decline (Dario et al., 2018).

Crucially, the results obtained from the phytosanitary survey demonstrated the absence of major quarantine pests, such as Citrus Canker (*Xanthomonas citri* subsp. *citri*) and Huanglongbing (*Candidatus* Liberibacter spp.), across the evaluated citrus production units in the Litoral Norte and Agreste Baiano Territory.

Therefore, the findings of this study corroborate the importance of maintaining continuous sanitary education, regulatory inspection, and phytosanitary monitoring programs conducted by ADAB. The integration of farmer outreach initiatives with systematic phytosanitary surveys contributes to the early detection of potential quarantine pest outbreaks and safeguards the phytosanitary status of Bahian citrus farming.

CONCLUSION

IBGE (2024) data confirm the prominence of sweet orange, Tahiti acid lime, and mandarin crops in the Litoral Norte and Agreste Baiano Territory, where production dynamics reflect consumer market demand alongside the high adaptability of these species to regional edaphoclimatic conditions.

The phytosanitary survey conducted across 137 Production Units revealed a diverse assemblage of non-quarantine pests, dominated by citrus snow scale (*Unaspis citri*), citrus leafminer (*Phyllocnistis citrella*), and gummosis (*Phytophthora* spp.) findings that align with previous studies on the primary phytosanitary constraints in Brazilian citrus production.

Conversely, no quarantine pests were detected within the surveyed areas, indicating favorable phytosanitary conditions across the sampled production units. These findings reinforce the need for ongoing phytosanitary surveillance, systematic monitoring, and sanitary education led by the Agricultural Defense Agency of Bahia (ADAB).

REFERENCES

BATUMAN, O.; et al. Citrus diseases: a practical guide. Springer, 2020

DARIO, G. J.; et al. Phytophthora spp. em citros: epidemiologia e manejo. Revista Brasileira de Fruticultura, 2018

EMBRAPA. *Manual prático para o monitoramento e controle de pragas da lima ácida Tahiti***.** Brasília, DF: Embrapa, 2009

FAO – FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS. Citrus fruits: world production statistics. Disponível em: https://www.fao.org. Acesso em: 4 out. 2024

FUNDECITRUS. Relatório técnico da citricultura brasileira. Araraquara: Fundecitrus, 2025

GABRIEL, D.; et al. Doenças dos citros: diagnóstico e manejo. Piracicaba: FEALQ, 2020

MAPA. MINISTÉRIO DA AGRICULTURA E PECUÁRIA. *Instrução Normativa nº 52, de 20 de novembro de 2007***.** Brasília, DF, 2007

MÜLLER, G. W.; et al. Tristeza dos citros: epidemiologia e controle. Revista Brasileira de Fruticultura, 2019.