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ORIGINAL RESEARCH ARTICLE

Farmers' knowledge, attitudes, and management practices regarding *Tuta absoluta* in Xumbowayne village, Maroodijeex district, Somaliland

Omer Osman[1*], Jamaal Barre[2] and Abdirahman Mohamed Abdirahman[3]

Department of Agriculture and Natural Resource Management, Gollis University, Hargeisa, Somaliland
[*]Corresponding author's E-mail: barre4a@gmail.com

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ABSTRACT

This study assessed farmers' knowledge, attitudes, and management practices (KAP) regarding *Tuta absoluta* in Xumbowayne Village, Maroodijeex District, Somaliland, and examined gaps between knowledge and practice. A simple random sampling technique was employed to collect data from 118 participants using a structured interview schedule and focus group discussions (FGDs). Descriptive statistics, chi-square tests, and Cramér's V were applied for data analysis. Results showed that while most farmers had high knowledge (72.0%), the majority exhibited low attitudes (66.1%) and moderate practices (89.8%), with 72.0% falling under low overall KAP. Chemical control was found the dominant strategy, with limited adoption of integrated pest management (IPM). Although KAP components were significantly associated, higher knowledge did not translate into better practices. Education ($V = 0.841$, $p < 0.001$) and farm size ($V = 0.508$, $p < 0.001$) significantly influenced knowledge and management practices. Therefore, the findings of this study reveal a clear knowledge practice gap driven by institutional and resource constraints, highlighting the need for improved extension services and practical IPM interventions.

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INTRODUCTION

Tomato (*Solanum lycopersicum* L.) is an edible herbaceous plant that originated in South and Central America and is now widely cultivated across diverse agro-ecological zones worldwide (Fuentes *et al*., 2021). Three countries (China, India, and the United States) accounted for more than 55% of the world's tomato production in 2023, totaling more than 192 million metric tons (FAOSTAT, 2023). In Africa, Egypt remains the largest tomato producer, reflecting the crop's strong economic and dietary importance across the continent (MALR, 2020). In Somaliland, tomato is among the most widely grown and consumed vegetable crops, with production distributed across irrigated and peri-urban farming systems throughout the country (MoAD, 2026). Nutritionally, tomato fruits are a rich source of essential micronutrients and bioactive compounds, including vitamin C, carotenoids, lycopene, and glycoalkaloids, which contribute to their antioxidant and health-promoting properties (Wang *et al*., 2023; Chen *et al*., 2023). They also contain appreciable amounts of ascorbic acid, amino acids, and essential minerals, making them a valuable component of human diets. Beyond their nutritional value, tomatoes play a critical socio-economic role by generating income and employment opportunities along the production, marketing, and processing value chains, thereby contributing significantly to both household livelihoods and national economies (Jamilu *et al*., 2024).

Despite its importance, tomato production is constrained by several biotic stress factors, particularly insect pests (Dereyko *et al*., 2023). Among these, *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae), commonly known as the South American tomato leaf miner, is one of the most destructive and globally invasive pests affecting tomato production systems (Desneux *et al*., 2010; Biondi *et al*., 2018). Originating from South America, particularly Peru, the pest has rapidly expanded its geographical

range, first being reported in Africa in 2008 (Rwomushana *et al*., 2019). In Somaliland, it was first documented in 2014 and has since become a major constraint to tomato production (Mutamiswa *et al*., 2017).

T. absoluta is now recognized as a key biotic limitation to tomato production under both greenhouse and open-field conditions (Gözel *et al*., 2020). Its larval stages feed extensively on leaves, stems, and fruits, thereby reducing photosynthetic efficiency, impairing plant growth, and ultimately causing significant yield losses (Mahlangu *et al*., 2025; Sperdouli *et al*., 2022). In addition to direct feeding damage, infestation also predisposes plants to secondary infections by pathogens entering through feeding wounds, further exacerbating post-infestation losses in yield and fruit quality (Poudel & Kafle, 2021). Under severe infestation conditions, yield losses may reach up to 100%, and in extreme cases, complete crop failure has been reported (Pandey *et al*., 2023).

In Somaliland, tomato is an important crop for smallholder farmers, contributing significantly to household income, employment generation, and local food supply systems (MoAD, 2026). However, in recent years, its productivity has been increasingly undermined by persistent infestations of *T. absoluta*, particularly in intensive production areas such as Xumbowayne, where tomato cultivation has expanded but yields remain low due to inadequate pest control. Although awareness of *T. absoluta* has increased among farmers, effective management practices remain limited. Existing evidence suggests that while farmers may possess basic knowledge of the pest, this knowledge is not consistently translated into effective control measures. This indicates a persistent knowledge practice gap driven not solely by awareness deficits, but also by institutional, economic, and technical constraints limiting adoption of integrated pest management (IPM) strategies. Unlike conventional Knowledge Attitude Practice (KAP) studies that rely primarily on Likert-scale quantification, the present study adopts a more behaviorally grounded and context-sensitive approach, integrating both quantitative and qualitative methods. This enables a deeper understanding of how farmers perceive, interpret, and respond to *Tuta absoluta* under real-world production conditions. Addressing this knowledge practice gap is essential for designing effective, context-specific interventions aimed at improving IPM adoption and enhancing sustainable tomato production in Somaliland.

MATERIALS AND METHODS

About the study area

This study was conducted in Xumbowayne village during the growing season. Xumbowayne is located approximately 35 km from Hargeisa, the capital city of Somaliland, at about 9.7°N and 44.2°E in Figure 1. The area is characterized by a mixed farming system in which both crop production and livestock rearing are practiced in the region. Farmers cultivate a range of crops, including vegetables such as tomatoes, onions, cabbage, and hot peppers, as well as fruits such as papaya, mango, and citrus (MoAD, 2026).

Research design, approach, and sampling procedure

This study employed a cross-sectional research design that combined both quantitative and qualitative approaches to provide a comprehensive understanding of farmers' responses to *Tuta absoluta*. Quantitative data were collected using a semi-structured questionnaire administered to tomato-growing farmers. The questionnaire was designed to capture a range of information, including socio-demographic characteristics, farmers' knowledge, its occurrence, impact, and the management practices. Additionally, the researchers conducted one focus group discussions (FGDs) with selected farmers. A total of nine participants were purposively selected, including three community leaders and six experienced farmers based on farming experience and involvement in tomato production. These qualitative methods provided deeper insights into farmers' knowledge, perceptions, and practices regarding *T. absoluta*, complementing the quantitative findings within the KAP framework. The integration of quantitative and qualitative methods allowed the study to move beyond simple measurements and better understand how farmers interpret and respond to problems in practice. Moreover, the study population comprised 165 tomato-growing farmers and the sample size was calculated using the formula of Yamane (1967) with a 5% margin of error, resulting in a sample of 118 farmer's households, with all households selected through simple random sampling.

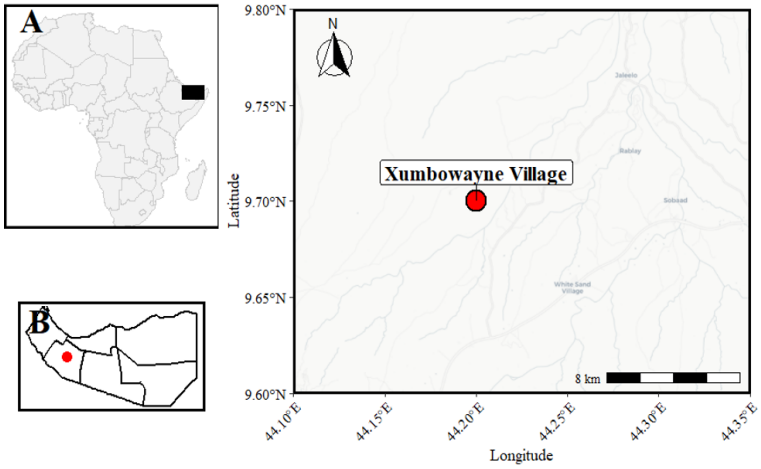

Figure 1. *Map showing the study area.*

Knowledge, Attitude, and Practice (KAP) Measurement Framework

This study employed a Knowledge, Attitude, and Practice (KAP) framework to assess farmers' awareness, perceptions, and management behaviors regarding *T. absoluta*. Unlike conventional KAP studies that rely mainly on Likert-scale responses, this study adopted a behaviorally grounded approach using practical and context-specific indicators derived from field survey data, which was considered appropriate for the local farming context. The knowledge component evaluated farmers' ability to identify *T. absoluta*, recognize infestation symptoms, and understand key aspects of the pest's biology and management. Correct responses were scored as one, while incorrect or uncertain responses received zero. The total scores were categorized into low, medium, and high knowledge levels.

Attitude was assessed based on farmers' perceptions of the severity, economic impact, spread, and prevention of *T. absoluta*. Positive responses were assigned a score of one, whereas negative or uncertain responses received zero. The cumulative scores were subsequently classified into low, medium, and high attitude categories. The practice component assessed farmers' pest management behaviors, particularly the adoption of integrated pest management (IPM) strategies. Farmers implementing preventive and integrated control measures with reduced dependence on synthetic pesticides were categorized as having good practices. Those relying solely on chemical control but applying pesticides appropriately were classified as moderate practitioners, while respondents using ineffective or no control measures were categorized as having low practices. A composite KAP index was generated by standardizing the scores of the three components to a 0–100 scale and calculating their average. The overall KAP levels were then categorized into low, moderate, and high levels to provide a comprehensive assessment of farmers' awareness and management behavior regarding *T. absoluta*.

Data analysis

Descriptive statistics, including frequencies, and percentages were used to summarize respondents' socio-demographic characteristics and assess farmers' knowledge, attitudes, and practices (KAP) regarding *T. absoluta*. Chi-square (χ^2) test was employed to assess associations between socio-demographic variables and KAP levels. FGD data were analysed using content analysis, with recorded discussions broken into meaningful units to identify patterns and capture respondents' values and attitudes. All statistical analyses were carried out using STATA version 16.0.

RESULTS AND DISCUSSION

Socio-demographic characteristics of respondents

As depicted in Table 1, the vast majority 97.5% of the respondents were males, while females account for 2.5%, indicating that farming activities in the study area are predominantly undertaken by men. This pattern is consistent with Mohamoud & Omer (2026) who reported similar male dominance in agricultural production systems, reflecting broader structural constraints that limit women's participation in farm decision-making and resource access. Nearly half of the respondents 46.6% fall within the 25–34-year age category, indicating that tomato production is predominantly undertaken by young and economically active individuals. Moreover, most 94.1% of participants had more than five years of farming experience, whereas only 5.9 had less than five years, indicating a generally experienced farming population. Furthermore, 63.6% of respondents operated on less than 1.5 hectares of land, reflecting that tomato production in the study area is predominantly small-scale in nature (Table 1).

Table 1. Socio-demographic profile of farmers.

Variable	Category	Frequency	Percent (%)
Sex	Male	115	97.5
	Female	3	2.5
Age	15–24	9	7.6
	25–34	55	46.6
	35–45	25	21.2
	46–55	19	16.1
	>55	10	8.5
Farm size (ha)	0.5–1.5	75	63.6
	1.6–2.6	36	30.5
	>2.6	7	5.9
Farming experience	<5 years	7	5.9
	>5 years	111	94.1

Source: Field survey data, 2024.

Table 2. Levels of knowledge, attitude, and practice among farmers.

Component	Category	Frequency	Percent (%)
Knowledge	High	85	72.0
	Medium	21	17.8
	Low	12	10.2
Attitude	Low	78	66.1
	Medium	36	30.5
	High	4	3.4
Practice	Moderate	106	89.8
	Good	12	10.2

Note: No respondents were classified under low practice, indicating that all farmers applied at least basic pest management measures.

Table 3. Overall KAP level of farmers.

KAP Level	Frequency	Percent (%)
Low	85	72.0
Moderate	24	20.3
High	9	7.6
Total	118	100.0

Source: Field survey data, 2024.

Knowledge, attitude, and practice (KAP) about *T. absoluta* of farmers

The assessment of farmers' Knowledge, Attitude, and Practice (KAP) regarding *T. absoluta* revealed a pronounced disconnect between knowledge acquisition and practical implementation at the farm level. Although a substantial proportion of respondents (72.0%) demonstrated high levels of knowledge about the pest, this did not translate into positive attitudes or the adoption of effective management strategies. Likewise, "FGD participants similarly reported that although they are aware of the pest and its damage, economic constraints often prevent them from adopting recommended management practice". This inconsistency is consistent with Chepchirchir *et al.* (2021), who observed that in many East African smallholder farming systems, high levels of awareness often fail to result in improved practices due to structural and resource-related constraints. Farmers' attitudes toward *T. absoluta* management were largely unfavorable, with 66.1% exhibiting low attitude levels and only a very small fraction 3.4% (Table 2). This pattern reflects the concept of resource-induced fatalism described by Mumo *et al.* (2023), where increased awareness of pest severity, in the absence of accessible and effective control options, leads to pessimism and reduced motivation to adopt sustainable pest management strategies. Such negative attitudes may undermine long-term engagement with Integrated Pest Management (IPM) approaches. Similarly, the adoption of appropriate pest management practices remained limited. Most (89.8%) of respondents were categorized under moderate practice levels, primarily relying on routine synthetic pesticide applications with minimal integration of cultural or biological control measures (Ndereyimana *et al.*, 2020), Only 10.2% of farmers demonstrated good practices, indicating substantial constraints to IPM adoption. According to Tarusikirwa *et al.* (2020), these challenges are less associated with knowledge deficits and more strongly linked to institutional weaknesses, limited extension services, and inadequate access to affordable IPM technologies.

Association among Knowledge, Attitude, and Practice (KAP) components

Table 3 reveals statistically significant associations among all KAP components ($p < 0.001$), indicating a strong interdependence between farmers' knowledge, attitudes, and practices regarding *T. absoluta* management. However, despite these statistically robust relationships, the findings also expose a clear disjunction between cognitive understanding and actual field-level pest management behavior. Furthermore, "FGD participants noted that, despite awareness of IPM principles, farmers' decisions are largely shaped by limited access to inputs and the widespread availability of chemical pesticide". This finding is consistent with previous studies reporting that improved knowledge does not automatically translate into effective practice adoption in smallholder farming systems affected by *T. absoluta* (Chepchirchir *et al.*, 2021). Notably, the strong association between knowledge and attitude (Cramér's V = 0.707) suggests that increased awareness is closely linked to more informed perceptions and risk recognition. However, the persistence of suboptimal management practices implies that attitudinal change alone is insufficient to drive behavioral transformation. This weak knowledge practice translation reflects the presence of structural and systemic constraints, including limited access to affordable and effective control inputs, inadequate extension services, pesticide misuse, and economic vulnerability among smallholder farmers (Wangari Nderitu *et al.*, 2020). The result in Table 3 further reveals a significant association was also observed between knowledge and practice (Cramér's V = 0.545), indicating that high knowledge did not result in improved management practices. Despite being well informed about *T. absoluta*, most farmers continued to depend on chemical pesticides, reflecting limited adoption of Integrated Pest Management (IPM) approaches. The attitude practice association was similarly significant (Cramér's V = 0.508), suggesting that farmers with more favorable attitudes were more likely to adopt improved management practices. These findings support previous studies showing that sustainable pest management is influenced not only by knowledge but also by access to resources and institutional support (Tarusikirwa *et al.*, 2020). Overall, the results highlight a substantial knowledge–practice gap, indicating that improving *T. absoluta* management requires not only awareness creation but also greater access to affordable IPM technologies, extension services, and financial support.

Table 4. Association between KAP components (Chi-square and Cramér's V).

Variables Compared	χ^2 Value	p-value	Cramér's V	Strength of Association
Knowledge vs Attitude	117.82	0.000	0.707	Very strong
Knowledge vs Practice	34.99	0.000	0.545	Strong
Attitude vs Practice	30.43	0.000	0.508	Strong

Table 5. Association between socio-demographic factors and KAP variables (Chi-square and Cramér's V).

Variables Compared	χ^2 Value	p-value	Cramér's V	Strength of Association
Education vs Knowledge	83.47	0.000	0.841	Very strong
Farming experience vs Knowledge	1.24	0.537	0.103	Weak
Farm size vs Practice	30.43	0.000	0.508	Strong
Age vs Practice	9.73	0.045	0.287	Moderate
Sex vs Practice	0.35	0.555	0.054	No meaningful association

Source: Field survey data, 2024.

Socio-demographic factors and KAP

Tables 4 and 5 shows a strong association between education level and knowledge of *T. absoluta* (Cramér's V = 0.841, $p < 0.001$), indicating a very strong effect size. Interestingly, farmers without formal education exhibited higher knowledge levels than those with formal schooling. This counterintuitive result suggests that knowledge is predominantly acquired through experiential learning, including field experience, farmer-to-farmer exchange, and extension interactions, rather than formal education systems. This aligns with Chepchirchir *et al.* (2021), who highlighted experiential learning and targeted training as more influential than formal education in shaping pest knowledge and management decisions among smallholder farmers. Similarly, farm size was significantly associated with pest management practices (V = 0.508, $p < 0.001$), indicating a moderate-to-strong relationship. Farmers with medium-sized holdings (1.6–2.6 ha) demonstrated comparatively better management practices, likely due to greater financial capacity to invest in inputs and implement recommended control measures. Age was also moderately associated with management practices (V = 0.287, $p = 0.045$), suggesting a weaker but meaningful influence, with older farmers showing relatively improved practices, possibly due to accumulated experience and repeated exposure to pest outbreaks. In contrast, farming experience and sex were not significantly associated with management practices, indicating limited influence on farmers' adoption of *T. absoluta* control strategies in the study area.

Conclusion

In this study we assessed farmers' knowledge, attitudes, and management practices regarding *T. absoluta* in Xumbowayne Village and identified a significant gap between knowledge and practice. Although most farmers demonstrated high awareness of the pest, this did not translate into appropriate attitudes or effective management practices. The majority relied on chemical control, with limited adoption of integrated pest management strategies. The findings indicated that the relationship between knowledge and practice is not linear, as behavioral and structural constraints limit the application of knowledge. Factors such as weak extension services, limited access to inputs, inadequate training, and financial constraints play a more critical role than awareness alone in shaping farmers' decisions. To effectively manage *T. absoluta*, interventions should move beyond awareness creation and focus on strengthening extension systems, promoting farmer field-based training, and improving access to affordable IPM technologies. Policies should prioritize practical, context-specific solutions that enable farmers to adopt sustainable pest management practices. Bridging the knowledge practice gap is essential for improving tomato productivity and ensuring long-term agricultural sustainability in the region.

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DECLARATIONS

Authors contribution statement: Conceptualization, methodology: O.O and J.B; Conception/design: J.B. development of data collection instrument, J.B. and O.O; Data curation interpretation of data, Writing -original draft preparation: A.M.A, supervision, and correction of final draft. All authors have read and agreed to the published version of the manuscript.

Conflicts of interest: The authors declare that there are no conflicts of interest regarding the publication of this manuscript.

Ethics approval: This study was conducted in view of the institutional ethical guidelines and does not harm the human participants.

Consent for publication: All co-authors gave their consent to publish this paper in AAES.

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