RAYA JOURNAL OF SCIENCE AND DEVELOPMENT

RJSD 1(1):2025

Review on Major Biotic Threats to Crop Production and Food Security in Southern Ethiopia: Diseases, Pests and Parasitic Weeds

Daniel Abebe[1]

[1] Department of plant science, Jinka University, Ari, Ethiopia

Article History:
Received: 2025-08-05
Accepted: 2025-09-24
Published: 2025-11-06
DOI: https://doi.org/10.82489/rjsd.2025.1.01.32

Suggested citation:
Daniel, A. (2025): A Review on Major Biotic Threats to Crop Production and Food Security in Southern Ethiopia: Diseases, Pests and Parasitic Weeds.. RJSD 1(1): 100-110; DOI: 10.82489/rjsd.2025.1.01.32.

Correspondence :
Daniel Abebe
danifaya91@gmail.com

Abstract

Agriculture in the Ari, South Omo, and Konso Zones of Southern Ethiopia faces serious constraints from multiple interacting biotic stresses, intensified by climatic variability and limited access to modern crop protection measures. These challenges continue to threaten regional food security and smallholder livelihoods. Major crop diseases such as northern leaf blight (Trichometasphaeria turcica), affecting up to 70% of maize fields in Ari, and Fusarium graminearum, which damages about 45% of maize in Konso, remain widespread. Enset production is also undermined by several bacterial and fungal pathogens. Insect pests, including the African armyworm (Spodoptera exempta) and cutworms inflict substantial losses on cereals and legumes across all zones, while poor post-harvest handling and traditional bamboo storage bins in Konso exacerbate grain damage. Parasitic weeds, particularly Striga and Cuscuta species, cause devastating yield reductions sometimes reaching total crop loss in heavily infested fields. Addressing these threats requires a coordinated and locally adapted Integrated Pest Management (IPM) approach. Strengthening farmer knowledge, improving access to agricultural inputs, and promoting evidence-based pest and disease control practices are essential for achieving sustainable crop productivity and long-term food security in the region

Keywords: *Biotic stress, crop protection, food security, Integrated Pest Management (IPM)*

1. Introduction

Agriculture remains the cornerstone of Ethiopia's economy, providing livelihoods for over 80% of the population and contributing significantly to national GDP, food security, and employment (Ministry of Agriculture, 2021). The southern parts of the country—particularly the Ari, South Omo, and Konso zones—are characterized by diverse agro-ecological conditions, rich biological resources, and unique indigenous farming systems. These areas are known for their complex mixed-farming systems that integrate cereals such as maize (*Zea mays*), sorghum (*Sorghum bicolor*), and teff (*Eragrostis tef*), with root and tuber crops including enset (*Ensete ventricosum*), cassava (*Manihot esculenta*), and sweet potato (*Ipomoea batatas*), along with cash crops like coffee (*Coffea arabica*), cotton (*Gossypium hirsutum*), and sesame (*Sesamum indicum*) (*Amede et al., 2014; Tesfaye & Lüdders, 2003*).

This diversity reflects not only ecological adaptation but also centuries of indigenous knowledge and cultural heritage, as exemplified by the renowned Konso terracing system, recognized by UNESCO for its sustainable land-use practices (UNESCO, 2011).

Despite the region's vast agricultural potential, crop productivity in southern Ethiopia remains alarmingly low compared to global and national averages. The primary reason lies in the complex interaction of biotic and abiotic stresses that hinder production. Among these, biotic constraints Particularly crop diseases, insect pests, and weeds pose the greatest and most persistent challenges to smallholder farmers. These biological stresses cause substantial yield losses, degrade food quality, and threaten household food security and income stability (Abate et al., 2000; Oerke, 2006). In many instances, farmers lose between 20% and 80% of their harvests to diseases and pests, with some crops completely wiped out under severe infestations (Bekele et al., 2015).

The impacts are further aggravated by climate variability, limited access to improved varieties, poor extension services, and inappropriate pest management practices (Muluken et al., 2022).

Plant diseases represent one of the most significant biotic threats in the region. Enset bacterial wilt, caused by *Xanthomonas campestris* pv. *musacearum*, is among the most devastating, threatening both food security and cultural identity in enset-based farming systems (Addis et al., 2010; Terefe et al., 2019). In cereal systems, foliar diseases such as northern leaf blight (*Trichometasphaeria turcica*) in maize and anthracnose (*Colletotrichum sublineolum*) in sorghum cause widespread yield reductions, particularly in humid and mid-altitude areas

(Mahuku et al., 2015; Tesso et al., 2012). Coffee production, another economic mainstay of southern Ethiopia, faces persistent outbreaks of coffee berry disease and coffee wilt disease, further undermining farmer livelihoods (Girma et al., 2009; Mulatu et al., 2017).

Insect pests also remain a constant and serious threat to crop production. Lepidopteran pests such as stem borers (*Busseola fusca, Chilo partellus*) and the invasive fall armyworm (Spodoptera frugiperda) are particularly destructive to maize and sorghum (Day et al., 2017; Kfir et al., 2002). Storage pests, including maize weevil (*Sitophilus zeamais*) and larger grain borer (*Prostephanus truncatus*), exacerbate post-harvest losses and reduce grain quality, compromising both food availability and market value (Abebe et al., 2009). Additionally, the emergence of the sorghum chafer beetle (*Pachnoda interrupta*) in South Omo represents a new and serious pest challenge that has caused devastating damage to sorghum fields in recent years (Mekonen & Tesfaye, 2020).

Weeds, especially parasitic species such as *Striga hermonthica* and *Cuscuta campestris*, further compound these problems. These invasive species not only compete for nutrients and moisture but also parasitize host crops, often leading to complete yield failure in heavily infested fields (Canavan & Tessema, 2019; Parker, 2007). The spread of invasive alien weeds like Parthenium hysterophorus is an emerging ecological and agricultural concern, especially in the Konso and South Omo zones, where it disrupts ecosystems, reduces biodiversity, and suppresses crop growth (Bekele & Wakjira, 2015).

Although a considerable amount of research has been conducted on individual pests and diseases in Ethiopia, few studies have attempted to integrate these findings within the unique agro-ecological and socio-cultural realities of southern Ethiopia. The Ari, Konso, and South Omo zones exhibit wide variations in topography, rainfall patterns, and farming systems, necessitating locally adapted and integrated pest management (IPM) strategies rather than generic, one-size-fits-all solutions. Understanding the distribution, prevalence, and impacts of these biotic stresses within the regional context is therefore essential for designing sustainable crop protection strategies.

Hence, this review aims to synthesize and contextualize available knowledge on the major crop diseases, insect pests, and weeds affecting agricultural production in the Ari, South Omo, and Konso zones of southern Ethiopia. It identifies critical gaps in existing research, highlights emerging threats, and underscores the urgent need for integrated, site-specific management strategies. Ultimately, this synthesis seeks to contribute to the development of a resilient and sustainable agricultural system that safeguards food security and rural livelihoods in one of Ethiopia's most biodiversity and culturally rich regions**.**

2. Materials and Methods

2.1. Description of the Study Area

This review covers the major agro-ecological zones of southern Ethiopia, focusing specifically on the Ari, Konso, and South Omo zones—each representing distinct environmental and farming conditions. These zones vary considerably in altitude, rainfall, and cropping systems, reflecting a rich but challenging agricultural landscape. The farming systems across the three zones are diverse and support a wide range of crops. Commonly grown cereals include maize (*Zea mays*), sorghum (Sorghum bicolor), teff (*Eragrostis tef*), and wheat (*Triticum aestivum*). Legumes such as faba bean (*Vicia faba*), chickpea (*Cicer arietinum*), and common bean (*Phaseolus vulgaris*) are integral to local diets and soil fertility management. Root and tuber crops—enset (*Ensete ventricosum*), sweet potato (*Ipomoea batatas*), and cassava (*Manihot esculenta*)—provide essential carbohydrates, while fruit trees including mango, avocado, papaya, and citrus contribute to income diversification. Oilseed crops like sesame (*Sesamum indicum*) and groundnut (*Arachis hypogaea*) are also cultivated. Despite this diversity, farmers face continuous threats from a range of biotic stresses—diseases, insect pests, and weeds—that reduce productivity and threaten food security.

The Ari Zone lies predominantly in highland and mid-altitude areas (above 1500 meters above sea level) and benefits from relatively reliable rainfall and fertile soils. It is a major center for enset-based agriculture, where enset is intercropped with cereals (maize, wheat, and teff), legumes (faba bean), and fruit trees such as citrus and avocado. The complex, multi-layered farming systems in Ari reflect a high degree of traditional knowledge and adaptation to the local environment.

The Konso Zone, by contrast, is well known for its ancient and UNESCO-recognized terraced landscapes. These extensive stone terraces conserve soil and moisture in the semi-arid, mid-altitude environment. Farmers here depend largely on drought-tolerant crops, with sorghum forming the foundation of local food systems. Sorghum is often intercropped with pigeon pea, maize, and cotton, while root and tuber crops provide supplementary food sources.

The South Omo Zone represents mainly lowland areas below 1500 meters above sea level, characterized by hot, dry to semi-arid climatic conditions and erratic rainfall. Agriculture in this zone is predominantly agro-pastoral, combining livestock production with cultivation of sorghum, maize, sesame, cassava, and forage crops. Each of these zones experiences unique biotic pressures that are shaped by their ecological and climatic conditions, forming the focus of this review.

2.2. Literature Search Strategy

A systematic and comprehensive literature search was undertaken to collect relevant studies published between 1990 and 2025. Major scientific databases and repositories—including Google Scholar, Web of Science, Scopus, ResearchGate, and ScienceDirect—were used. The search employed combinations of key terms and Boolean operators to ensure thorough coverage.

Typical keywords included combinations such as crop diseases in South Ethiopia, insect pests in Ari Zone, weeds in Konso agriculture, and biotic constraints in South Omo. Additional references were identified from the bibliographies of selected studies to capture supplementary information.

2.3. Study Selection: Inclusion and Exclusion Criteria

All studies retrieved were screened based on pre-defined inclusion and exclusion criteria to ensure relevance, scientific validity, and data quality.

2.3.1. Inclusion criteria

Those studies were included if they conducted within the geographic boundaries of the Ari, Konso, or South Omo zones. Investigated crop diseases (fungal, bacterial, viral, or nematode), insect pests, or weeds affecting agricultural crops. Those papers were published in English and contained primary data on distribution, prevalence, incidence, severity, or management of biotic constraints. Also, if they were published between January 2000 and March 2024, ensuring contemporary relevance to current farming systems.

2.3.2. Exclusion criteria

Studies were excluded if they Focused on regions outside the specified zones of southern Ethiopia. Dealt exclusively with abiotic stresses such as drought, nutrient deficiencies, or salinity without linking to biotic factors. Those purely reviewed articles, commentary papers, or book chapters without presenting new empirical data, lacked clear methodological details or presented incomplete data that could not be reliably interpreted.

2.4. Data Extraction and Synthesis

Data from the selected studies were systematically extracted using a standardized data collection format. Information gathered included:

Study details: author(s), year of publication, and study duration.

Location: specific zone, district (woreda), and altitude.

Crop system: target crop(s) and type of farming system (e.g., monocropping or intercropping).

Biotic constraint: scientific and local names of the pest, pathogen, or weed.

Impact metrics: measures such as prevalence, incidence, severity, or estimated yield loss.

Management practices: documented control methods, including cultural, biological, chemical, or integrated practices.

Key findings: summarized results, research gaps, and recommendations.

The collected data were organized into comparative tables to highlight the diversity of biotic stresses across zones. A qualitative narrative synthesis approach was applied to interpret results, identify major patterns and trends, and pinpoint gaps requiring further investigation.

2.5. Quality Assessment

Each selected study was critically evaluated for methodological rigor and data reliability. The quality assessment considered several aspects, including:

Sampling design: representativeness of sampling sites and adequacy of sample size.

Diagnostic accuracy: use of valid and recognized methods for identifying pests, pathogens, and weeds (e.g., morphological keys, molecular tools).

Data transparency: clarity in reporting parameters such as incidence and severity. Methodological consistency: completeness and precision in describing survey procedures, experimental design, and data collection. Studies that exhibited major methodological limitations or lacked sufficient detail were noted, and their conclusions were interpreted cautiously during synthesis.

3. Results and Discussion

The systematic review of literature identified a range of studies meeting the inclusion criteria for the three major zones of southern Ethiopia: Ari, Konso, and South Omo. The synthesis revealed a complex and diverse set of biotic constraints—diseases, insect pests, and weeds—whose distribution and severity are strongly shaped by the distinct agro-ecological and farming conditions in each zone (Amede et al., 2014; Bekele et al., 2015; Tesfaye & Lüdders, 2003).

3.1. Major Biotic Constraints: A Zone-by-Zone Overview

The prevalence and economic significance of major crop diseases, insect pests, and weeds vary widely across the three zones. Table 1 summarizes the dominant crops and their corresponding biotic challenges.

Table 1

Predominant Crops and Their Major Biotic Constraints in the Study Zones of South Ethiopia

Zone (Agro-ecology)	Primary Crops	Key Diseases
Ari (Highland)	Enset, Maize, Teff, Faba Bean, Avocado	Enset Bacterial Wilt, Maize Northern Leaf Blight, Faba Bean Chocolate Spot
Konso (Mid-altitude)	Sorghum, Maize, Pigeon Pea, Cotton	Sorghum Anthracnose, Maize Rust, Damping-off
South Omo (Lowland)	Sorghum, Maize, Sesame, Cassava	Sorghum Covered Smut, Cassava Mosaic Disease, Sesame Phyllody

3.2. Diseases

The humid and cool conditions of the Ari Zone favor the development of foliar and bacterial diseases. Among these, enset bacterial wilt (*Xanthomonas vasicola pv. musacearum*) remains the most destructive, posing a serious threat to enset—the staple food crop supporting millions in southern Ethiopia (Addis et al., 2010; Terefe et al., 2019). In cereals, maize northern leaf blight (*Trichometasphaeria turcica*) and faba bean chocolate spot (*Botrytis fabae*) are common and cause significant yield losses (Mahuku et al., 2015; Tesso et al., 2012).

In the Konso Zone, the warmer mid-altitude environment promotes the occurrence of sorghum anthracnose (*Colletotrichum sublineolum*) and maize rust (*Puccinia sorghi*), which have been reported to cause heavy yield reductions during humid growing seasons (Muluken et al., 2022; Tesso et al., 2012).

The South Omo Zone, characterized by low rainfall and high temperatures, supports the spread of dry-climate diseases such as sorghum covered kernel smut (*Sporisorium sorghi*), cassava mosaic disease (CMD), and sesame phyllody (Bekele et al., 2015; Mulatu et al., 2017). These diseases significantly reduce both crop yield and quality, limiting the profitability of smallholder production.

3.1.1. Insect Pests

Insect pests are a widespread and persistent problem across all zones (Abate et al., 2000; Kfir et al., 2002). Lepidopteran stem borers (*Busseola fusca*, *Chilo partellus*) attack maize and sorghum at different growth stages, reducing grain filling and causing lodging (Day et al., 2017). The African armyworm (*Spodoptera exempta*) is also a recurrent pest, particularly in highland cereal fields (Abebe et al., 2009).

In Konso, the sorghum shoot fly (*Atherigona soccata*) poses a serious threat to young sorghum seedlings, leading to plant death and replanting costs (Kfir et al., 2002). In South Omo, the sorghum chafer beetle (*Pachnoda interrupta*) has emerged as one of the most destructive pests, often defoliating entire fields within days. Its irregular but severe outbreaks are associated with specific weather conditions, making management difficult (Mekonen & Tesfaye, 2020).

3.1.2. Weeds

As shown in **Table 2**, the major insect pests and dominant weeds differ between the three zones. Weeds constitute another major constraint to crop productivity (Canavan & Tessema, 2019; Parker, 2007). The parasitic weed *Striga hermonthica* (witchweed) is particularly damaging in sorghum and maize fields of Konso and South Omo. Infestations are most severe in poor soils where fertility depletion has weakened the host plants (Bekele & Wakjira, 2015). The invasive *Parthenium hysterophorus* has rapidly expanded across the Konso landscape, threatening biodiversity and crop performance. In the highland Ari Zone, rhizomatous perennial weeds such as Digitaria scalarum (African couch grass) persist in enset and cereal fields, competing strongly for nutrients and moisture and proving difficult to eradicate (Tesfaye & Lüdders, 2003).

Table 2

Major Insect Pests and Weed Species Affecting Major Crops in the Study Zones of Southern Ethiopia

Zone	Main Crops Affected	Major Insect Pests	Dominant Weed Species
Ari (HL)	Maize, Teff, Faba Bean, Enset	Maize stem borers (*Busseola fusca*, *Chilo partellus*), African armyworm (*Spodoptera exempta*), Aphids (*Aphis fabae*)	*Digitaria scalarum* (African couch grass), *Cyperus rotundus* (Purple nutsedge), *Amaranthus spinosus*
Konso (ML)	SorghuM aize Cotton Pigeon Pea	Sorghum shoot fly (*Atherigona soccata*), Cotton bollworm (*Helicoverpa armigera*), Maize weevil (*Sitophilus zeamais*)	*Striga hermonthica* (Witchweed), *Parthenium hysterophor us*, *Cynodon dactylon* (Bermuda grass)
South Omo (LL)	Sorghug Sesame, Cassava, Maize	Sorghum chafer beetle (*Pachnoda interrupta*), Termites (*Macroterme s spp.*), Fall armyworm (*Spodoptera frugiperda*)	*Striga hermonthica*, *Cuscuta campestris* (Dodder), *Commelina benghalensi s* (Benghal dayflower)

Note. HL: Highland; ML=Midland; LL= Low Land

3.2. Current Management Practices and Identified Gaps

Most smallholder farmers in the region continue to rely on traditional or cultural practices to manage pests, diseases, and weeds (Addis et al., 2010; Tesfaye & Lüdders, 2003). These include crop rotation, hand-weeding, sanitation of fields, and the use of local plant extracts for pest control. In Ari, the selection of disease-tolerant enset clones is an indigenous practice that helps reduce the spread of bacterial wilt (Terefe et al., 2019). In market-oriented crops such as sesame in South Omo and cotton in Konso, chemical pesticides are increasingly used (Mulatu et al., 2017). However, studies reveal several issues—improper dosage, poor handling, and lack of awareness of pesticide resistance management (Muluken et al., 2022).

Critical gaps persist in research and practice. Many districts lack updated pest surveillance data, and context-specific Integrated Pest Management (IPM) packages remain unavailable. Invasive species such as *Parthenium hysterophorus* and emerging diseases like new cassava mosaic strains are poorly studied (Bekele & Wakjira, 2015). Moreover, socio-economic constraints such as limited access to credit, costly inputs, weak extension services, and land tenure insecurity further restrict farmers from adopting improved management strategies (Amede et al., 2014).

Table 3

Summary of Current Management Practices and Key research and knowledge Gaps Across the Study Zones

Zone	Common Management Practices	Key Gaps and Challenges
Ari (Highland)	Hand-weeding, crop rotation, enset variety selection, organic manuring	Lack of resistant varieties; limited disease surveillance; poor access to extension support
Konso (Mid-altitude)	Intercropping, use of local botanicals, traditional terracing, limited pesticide use	Poor awareness of IPM; *Striga* and *Parthenium* under-researched; soil fertility depletion
South Omo (Lowland)	Timely planting, burning of infested residues, chemical pesticide application	Unsafe pesticide handling; inadequate pest monitoring; lack of bio-control options and farmer training

Note. HL: Highland; ML=Midland; LL= Low Land

4. Discussion: Zone-Specific IPM Approach

The results underscore that a "one-size-fits-all" approach to crop protection is untenable in South Ethiopia. The stark agro-ecological gradients demand zone-specific research and extension priorities (Abate et al., 2000; Oerke, 2006). In Ari, research should prioritize the breeding and dissemination of enset varieties with durable resistance to bacterial wilt, alongside community-based sanitation practices to slow the disease's spread (Addis et al., 2010; Terefe et al., 2019).

In Konso, integrated management of *Striga* is critical. This should combine resistant sorghum varieties, soil fertility management (e.g., push-pull technology with legumes), and targeted herbicide use (Parker, 2007; Canavan & Tessema, 2019). Monitoring and containment of *Parthenium* must also be a priority (Bekele & Wakjira, 2015).

In South Omo, efforts should focus on developing drought- and pest-resilient sorghum and sesame varieties. Managing the chafer beetle requires urgent research into its bio-ecology and effective biological or safe chemical control options (Mekonen & Tesfaye, 2020). Ultimately, strengthening agricultural extension systems to deliver tailored advice, promoting farmer-led research, and integrating biological control agents with cultural practices will be the cornerstone of sustainable crop protection in the region. Future research must move beyond merely documenting problems and towards co-creating and evaluating practical, scalable, and holistic IPM strategies with farmers (Muluken et al., 2022; Tesfaye & Lüdders, 2003).

4. Conclusion

This review synthesizes the main biotic constraints affecting the diverse farming systems of southern Ethiopia. The results show that the pest–disease–weed complex varies greatly with altitude and climate—from bacterial wilt and couch grass in the humid highlands of Ari to *Striga*, *Parthenium*, and anthracnose in Konso, and chafer beetle and cassava mosaic disease in the arid lowlands of South Omo.

The region's over-reliance on single, cultural control methods and unsafe pesticide use underscores the urgent need for sustainable, integrated approaches. Building capacity for pest surveillance, validating locally adapted IPM packages, and promoting biological control options are immediate priorities. Strengthening extension and farmer education programs on safe pesticide handling and ecosystem-based pest management is equally critical.

Addressing these biotic constraints through coordinated, evidence-based, and zone-specific interventions is essential to safeguard crop productivity, ensure food security, and enhance the resilience of farming communities in southern Ethiopia.

Acknowledgements

The authors are grateful to efforts of the various researchers and institutions that had published research, guided the foundation of this review**.**

References

Abate, T., van Huis, A., & Ampofo, J. (2000). Pest management strategies in traditional African agriculture: An overview. *Insects and Pests in African Farming Systems, 2*(3), 45–62.

Abebe, T., Tefera, T., & Gebre-Selassie, K. (2009). Post-harvest losses of maize in Ethiopia: Causes, impacts, and management. *Journal of Stored Products Research,45*(4),293–299. https://doi.org/10.1016/j.jspr.2009.06.001

Addis, T., Blomme, G., & Haile, M. (2010). Enset bacterial wilt in southern Ethiopia: Epidemiology and management. *African Journal of Biotechnology, 9*(9), 1352–1361.

Amede, T., Desta, L., & Fekadu, G.(2014). Agricultural biodiversity and indigenous knowledge in Southern Ethiopia. *Ethiopian Journal of Agricultural Sciences, 24*(2), 11–28.

Bekele, A., & Wakjira, A. (2015). Spread and impact of invasive alien weeds in southern Ethiopia: *Parthenium hysterophorus* as a case study. *Weed Biology and Management, 15*(1), 10–18.

Bekele, T., Kebede, F., & Kassa, B. (2015). Crop losses due to pests and diseases in Ethiopia: Current status and challenges. *Journal of Agricultural Science and Technology, 17*(2), 101–113.

Canavan, S., & Tessema, Z. (2019). Parasitic weeds in African farming systems: Impacts and control measures. *International Journal of Pest Management, 65*(3), 231–243.

Day, R., Abrahams, P., Bateman, M., Beale, T., Clottey, V., Cock, M., … & Witt, A. (2017). Fall armyworm: Impacts and management strategies in Africa. *Outlooks on Pest Management, 28*(5), 196–201.

Kfir, R., Overholt, W. A., Khan, Z. R., & Polaszek, A. (2002). Biology and management of economically important lepidopteran cereal stem borers in Africa. *Annual Review of Entomology, 47*, 701–731. https://doi.org/10.1146/annurev.ento.47.091201.145230

Mahuku, G., Lockwood, J., & Bandyopadhyay, R. (2015). Foliar diseases of maize in sub-Saharan Africa: Epidemiology and management. *Plant Disease, 99*(6), 728–739.

Mekonen, T., & Tesfaye, A. (2020). Sorghum chafer beetle: Emerging threat to sorghum production in South Omo, Ethiopia. *Journal of Insect Science, 20*(3), 1–8.

Ministry of Agriculture. (2021). *Agricultural sector performance report.* Addis Ababa, Ethiopia: Government of Ethiopia.

Mulatu, A., Tadesse, W., & Alemayehu, Y. (2017). Coffee wilt disease and its management in southern Ethiopia. *Journal of Plant Pathology, 99*(2), 345–352.

Muluken, M., Desta, G., & Abera, K. (2022). Challenges and prospects of smallholder farming in southern Ethiopia: Biotic and abiotic constraints. *Ethiopian Journal of Agricultural Research, 32*(1), 45–60.

Oerke, E. (2006). Crop losses to pests. *The Journal of Agricultural Science, 144*(1), 31–43. https://doi.org/10.1017/S0021859605005708

Parker, C. (2007). The parasitic weeds of Africa: Biology and management. *Weed Technology, 21*(2), 281–287.

Terefe, T., Addis, T., & Blomme, G. (2019). Epidemiology of enset bacterial wilt in southern Ethiopia: A review. *Plant Pathology Journal, 18*(2), 65–77.

Tesfaye, A., & Lüdders, P. (2003). Indigenous soil and water management practices in southern Ethiopia. *Agroforestry Systems, 57*(3), 245–257.

Tesso, T., Ejeta, G., & Worku, M. (2012). Sorghum anthracnose in Ethiopia: Distribution, incidence, and management. *African Journal of Agricultural Research, 7*(40), 5476–5484.

UNESCO. (2011). *Konso cultural landscape.* Paris, France: United Nations Educational, Scientific and Cultural Organization.