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Review Article

Northern Leaf Blight of Maize (*Exserohilum turcicum*) in Southern Ethiopia: Incidence, Distribution, Yield Losses, and Management Practices – A Narrative Review

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Abstract

Maize (*Zea mays* L.) is one of the most important cereal crops contributing significantly to food security, income generation, and livestock feed production. However, maize productivity is constrained by several biotic stresses, among which Northern Leaf Blight (NLB) caused by *Exserohilum turcicum,* is one of the most distractive foliar disease affecting maize production across different agro ecological zone, including Southern Ethiopia. This narrative review aimed to synthesize available information on the incidence, distribution, yield losses, and management practices of NLB in Southern Ethiopia relevant scientific Publication, research reports, field studies, and institutional documents were reviewed to evaluate the current status of the disease and identify major challenges affecting its sustainable management. The reviewed evidence indicated that NLB is widely distributed in maize growing areas of Southern Ethiopia, with disease occurrence and severity varying according to agro ecological conditions, cropping systems, cultivar susceptibility, and pathogen adaptation. favorable environmental conditions, including high relative humidity, moderate temperatures, prolonged leaf wetness, continuous maize cultivation, and the widespread use of susceptible varieties, contribute to disease development and epidemics outbreaks. Yield losses associated with NLB depend on disease severity, timing of infection, host susceptibility, and environmental conditions, with severe infections causing considerable reductions in grain yield. Current NCLB management practices mainly on the use of resistant or tolerant maize varieties, cultural practices, and fungicide application. However, the effectiveness of these approaches is limited by inadequate availability of improved seed, weak extension services, limited farmer awareness and insufficient diseases management approaches involving resistant varieties, improved agronomic practices, regularly disease surveillance, and rational fungicide use are essential for sustainable management of NLB in southern Ethiopia. strengthening maize breeding programs, improving seed deliver systems, and enhancing farmer- oriented disease management strategies are recommended to reduce the impact of NCLB and improved maize productivity in the region.

Keywords

Maize, Northern Leaf Blight, *Exserohilum Turcicum*, Disease Incidence t, Yield Loss, Disease Management, Southern Ethiopia

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1. Introduction

Maize (*Zea mays* L.) is one of the world's most important cereal crops, serving as stable food for more than 1 billion people and contributing substantially to food security, livestock feed, industrial row materials, and household income in sub-Saharan Africa. Maize is the dominate cereal crop cultivated by millions of smallholder farmers and plays a pivotal role in improving rural livelihoods and agriculture sustainability. In Ethiopia, maize ranks among the leading cereal crops in terms of production, cultivated area, and national food security. The crop is grown across diverse agro ecological zones, from lowland to highland environments, and contributes significantly to household consumption, livestock feed, and market income. However, national maize productivity remains below its genetic potential because of numerous biotic and abiotic constraints, including recurrent drought, declining soil fertility, limited adoption of improved technologies, insect pests, and plant diseases [1].

Among the major diseases affecting maize, Northern Leaf Blight (NLB), caused by *Exserohilum turcicum* (Pass.) K. J. Leonard & Suggs, is one of the most economically important foliar diseases worldwide. The pathogen infects maize foliage, producing elongated, elliptical, grayish-green to tan lesions that gradually enlarge into characteristic cigar-shaped necrotic lesions. Severe infection reduces the photo synthetically active leaf area, accelerates premature leaf senescence, weakens plant vigor, and ultimately decreases grain yield and quality. Yield losses vary considerably depending on cultivar susceptibility, disease severity, crop growth stage at infection, and prevailing environmental conditions, with losses ranging from 15% to over 70% under favorable epidemic conditions [2].

The development and spread of Northern Leaf Blight are strongly influenced by environmental conditions. Moderate temperatures (18–27 ℃), high relative humidity, frequent rainfall, prolonged leaf wetness, and continuous maize cultivation create ideal conditions for disease development and pathogen sporulation. Under these conditions, epidemics can develop rapidly, particularly when susceptible varieties are grown and disease onset occurs before tasseling or grain filling. Climate variability and increasing weather fluctuations are expected to further enhance the geographical distribution and severity of the disease in many maize-growing regions, making Northern Leaf Blight an increasingly important threat to sustainable maize production [3].

Southern Ethiopia is one of the country's principal maize-producing regions, encompassing diverse agro ecological zones ranging from lowland to highland environments. Maize is widely cultivated in Ari, South Omo, Wolaita, Gamo, Gofa, Gedeo, Konso, Koore, Basketo, Burji, Alle, and Derashe (Gardula), where it serves as both a staple food crop and a major source of household income. Favorable rainfall distribution, suitable temperatures, and relatively fertile soils support extensive maize cultivation throughout these areas. Nevertheless, maize productivity remains substantially below attainable levels because of numerous production constraints, among which plant diseases have become increasingly important [4].

Northern Leaf Blight has emerged as one of the most widespread and economically significant foliar diseases in Southern Ethiopia. The disease is particularly severe in mid-altitude and high-rainfall maize-growing areas in southern Ethiopia, where environmental conditions favor repeated infection cycles. Disease epidemics often result in substantial reductions in grain yield, biomass production, and fodder quality, thereby affecting both crop production and mixed crop–livestock farming systems that dominate the region [5, 6].

Several management strategies have been recommended to reduce the impact of Northern Leaf Blight, including the deployment of resistant maize varieties, crop rotation, residue management, balanced fertilizer application, timely planting, integrated disease management practices, and judicious fungicide use. Although these approaches have shown varying levels of effectiveness, disease outbreaks continue to occur frequently because of limited adoption of resistant cultivars, inadequate disease surveillance, changing climatic conditions, continuous maize cultivation, and insufficient integration of available management options. Consequently, Northern Leaf Blight remains an important production constraint for maize farmers across Southern Ethiopia [7, 8].

During the past two decades, numerous studies have investigated the occurrence, epidemiology, incidence, severity, and management of Northern Leaf Blight in different parts of Ethiopia. However, most published studies have been conducted at district or zonal levels, making the available information fragmented and geographically dispersed. Few attempts have been made to synthesize findings across the diverse agro ecological zones of Southern Ethiopia. Consequently, there is limited comprehensive understanding of disease distribution patterns, environmental risk factors, yield losses, and management effectiveness across maize-growing areas.

This review therefore aims to comprehensively synthesize published information on the occurrence, geographical distribution, epidemiology, incidence, severity, yield losses, economic importance, and integrated management of Northern Leaf Blight in Southern Ethiopia. Furthermore, the review identifies major knowledge gaps, research priorities, and future opportunities for strengthening integrated disease management strategies that enhance maize productivity, improve food security, and support sustainable agricultural development in Southern Ethiopia.

2. Review Methodology

This narrative review was conducted to synthesize and critically evaluate existing scientific knowledge on Northern Leaf

Blight (NLB) of maize, caused by *Exserohilum turcicum* (Pass.) K. J. Leonard & Suggs, with particular emphasis on Southern Ethiopia. The review aimed to provide a comprehensive understanding of the disease by integrating available evidence on its occurrence, geographical distribution, epidemiology, disease development, yield losses, economic importance, and management practices.

Relevant literature was identified through comprehensive searches of internationally recognized scientific databases and information sources, including Google Scholar, Scopus, Web of Science, Science Direct, CAB Direct, and institutional repositories of Ethiopian universities and agricultural research centers. Additional information was obtained from reports published by national and international organizations involved in agricultural research and crop protection. The literature search employed combinations of keywords and Boolean operators, including *"Northern Leaf Blight"*, *"Exserohilum turcicum"*, *"maize leaf blight"*, *"maize diseases in Ethiopia"*, *"Northern Corn Leaf Blight"*, *"disease incidence"*, *"disease severity"*, *"yield loss"*, *"epidemiology"*, *"integrated disease management"*, and *"Southern Ethiopia"*.

The review considered peer-reviewed journal articles, review papers, conference proceedings, graduate theses, dissertations, technical reports, and relevant institutional publications published primarily in English. Preference was given to studies conducted in Ethiopia, particularly those from Southern Ethiopia, because of their direct relevance to the review objectives. Nevertheless, studies from other countries were also included to provide broader scientific perspectives on pathogen biology, host–pathogen interactions, environmental influences on disease development, and advances in integrated disease management.

The collected literature was screened for relevance based on its contribution to the review objectives. Publications that addressed the occurrence, distribution, epidemiology, disease assessment, yield losses, environmental determinants, host resistance, cultural practices, biological control, chemical control, and integrated disease management of Northern Leaf Blight were retained for detailed evaluation. Duplicate publications and studies with insufficient scientific information or limited relevance were excluded.

Information extracted from the selected publications was critically analyzed and organized into major thematic areas, including disease occurrence and distribution, causal organism and symptomatology, epidemiology, factors influencing disease development, economic impact and yield losses, disease assessment methods, and management strategies. Evidence from different studies was synthesized qualitatively to identify consistent findings, compare regional experiences, highlight existing knowledge gaps, and identify future research priorities for the sustainable management of Northern Leaf Blight in Southern Ethiopia.

3. Results

3.1. Northern Leaf Blight Incidence, Severity, and Yield Loss in Selected Zones of Southern Ethiopia

Northern Leaf Blight (NLB), caused by *Exserohilum turcicum*, is one of the most destructive foliar diseases affecting maize production in Southern Ethiopia. Table 1 summarizes the incidence, severity, and estimated grain yield losses caused by NLB across selected maize-growing zones of the region. The results indicate that the disease is widely distributed and represents a major constraint to maize productivity.

The disease incidence ranged from 85.4% in Gofa Zone to 96.8% in Konso Zone, with an overall mean incidence of 91.2%, indicating that Northern Leaf Blight occurred in nearly all surveyed maize fields. Such consistently high incidence reflects the widespread establishment of *E. turcicum* under favorable environmental conditions that characterize many maize-producing areas of Southern Ethiopia. Moderate temperatures, high relative humidity, prolonged leaf wetness, and continuous maize cultivation provide suitable conditions for pathogen infection, survival, and dissemination.

Disease severity varied among the surveyed zones, ranging from 43.1% in Gofa to 71.3% in Konso, with a mean severity of 57.7% (Table 1). The variation in severity suggests differences in agro ecological conditions, maize genotype susceptibility, crop management practices, and disease pressure. Areas receiving prolonged rainfall and experiencing higher humidity generally showed greater disease severity because these conditions enhance pathogen infection, lesion expansion, and repeated sporulation. The observed differences further demonstrate that environmental conditions and local production practices strongly influence NLB development across Southern Ethiopia.

Estimated grain yield losses associated with NLB also varied among zones but consistently demonstrated the substantial economic impact of the disease. Yield loss ranged from 14.6% in Gofa Zone to 29.5% in Konso Zone, with an average estimated loss of 22.2% (Table 1). Severe infection reduces the effective photosynthetic leaf area during critical crop growth stages, resulting in poor grain filling, reduced kernel weight, and decreased grain yield. In addition to grain yield reduction, severe NLB infection may negatively affect the amount and feeding value of maize residues, which is an important livestock feed resource in mixed crop–livestock farming systems of Southern Ethiopia.

Overall, the high disease incidence, considerable severity levels, and associated yield reductions observed across the surveyed areas confirm that Northern Leaf Blight remains one of the most economically important foliar diseases limiting maize production in Southern Ethiopia. These findings highlight the need for strengthened disease surveillance, promotion of resistant maize varieties, improved agronomic practices, and implementation of integrated disease management strategies to reduce yield losses and enhance sustainable maize production.

Table 1. *Northern Leaf Blight incidence, severity, and estimated yield loss in selected zones of Southern Ethiopia.*

Zone	Disease incidence (%)	Disease severity (%)	Estimated yield loss (%)
Gamo	88.6	50.5	18.2
Gofa	85.4	43.1	14.6
Konso	96.8	71.3	29.5
South Omo	91.2	57.8	22.4
Special District (Derashe)	94.1	65.8	26.3
Mean	91.22	57.7	22.2

Source: [12, 13, 15, 16]

3.2. Distribution and Occurrence of Northern Leaf Blight in Southern Ethiopia

In Southern Ethiopia, Northern Leaf Blight has been reported in several maize-growing zones, including Wolaita, Gamo, Gofa, Gedeo, Konso, Derashe, Ari, and South Omo (Table 2). Disease occurrence is generally higher in areas that receive high seasonal rainfall and where maize is cultivated continuously without adequate crop rotation. The widespread use of susceptible maize varieties and the retention of infected crop residues also contribute to the persistence and spread of the disease.

Field surveys conducted in Southern Ethiopia have shown considerable variation in disease incidence and severity among zones. Areas with relatively cool and humid conditions, such as Gamo, Gedeo, and Wolaita, generally experience higher disease pressure than the relatively warmer lowland areas. However, favorable weather during the growing season can also result in severe disease outbreaks in Konso, Derashe, Ari, and South Omo. The increasing prevalence of Northern Leaf Blight in Southern Ethiopia indicates that the disease has become an important production constraint, causing substantial reductions in maize grain yield and quality.

Table 2. *Distribution and occurrence of Northern Leaf Blight in selected maize-growing zones of Southern Ethiopia.*

Zone	Occurrence	incidence (%)	severity (%)	Major factors influencing occurrence
Wolaita	High	45–85	30–70	High rainfall, humid climate, continuous maize cultivation
Sidama	High	40–82	28–68	Moderate temperature, prolonged leaf wetness, susceptible varieties
Gamo	Very High	50–90	35–75	High humidity, favorable mid-altitude environment
Gofa	High	40–80	30–65	Frequent rainfall, continuous maize production
Gedeo	High	45–85	30–70	Dense vegetation, high humidity, moderate temperature
Konso	Moderate–High	35–75	25–65	Seasonal rainfall, susceptible maize cultivars
Derashe	High	40–85	30–70	Warm humid conditions and maize mono-cropping
Ari	High	40–80	28–68	High rainfall, favorable environmental conditions
South Omo	Moderate–High	30–70	20–60	Seasonal rainfall and localized humid conditions

Source: Authors' compilation and synthesis based on [11-13, 15, 16].

3.3. Management of Management Options for Northern Leaf Blight of Maize in Southern Ethiopia

Northern Leaf Blight (NLB), caused by *Exserohilum turcicum*, is one of the most destructive foliar diseases affecting maize production in Southern Ethiopia. Effective management of the disease requires an integrated disease management (IDM) approach that combines resistant varieties, cultural practices, regular field monitoring, and, where economically justified, fungicide application (Table 3). Because the pathogen survives on infected crop residues and spreads rapidly under cool, humid conditions, no single management practice provides complete control. Therefore, integrating several complementary strategies is the most effective and sustainable approach for reducing disease incidence, severity, and yield loss. The use of resistant or tolerant maize varieties is the most economical and environmentally friendly method of managing Northern Leaf Blight. Resistant varieties reduce disease development and minimize yield losses without increasing production costs. Farmers in Southern Ethiopia are encouraged to plant improved maize varieties with resistance or tolerance to *E. turcicum*, particularly in areas where the disease occurs frequently. Cultural practices also play a significant role in disease management. Crop rotation with non-host crops such as legumes helps reduce the amount of pathogen inoculum that survives in maize residues. Similarly, destroying or incorporating infected crop residues after harvest reduces the survival of the pathogen and lowers disease pressure in the following season. Planting at the recommended time, maintaining optimum plant spacing, controlling weeds, and applying balanced fertilizers improve crop vigor and reduce disease severity. Regular field scouting and disease monitoring are important for early detection of Northern Leaf Blight. Farmers should inspect maize fields from the vegetative stage through tasseling to identify the first appearance of characteristic elongated gray-green lesions. Early detection enables timely implementation of appropriate management measures before the disease spreads throughout the field.

Table 3. *Management options for Northern Leaf Blight of maize in Southern Ethiopia.*

Management option	Recommended practice	Expected benefit
Resistant varieties	Plant maize varieties with resistance or tolerance to Northern Leaf Blight	Reduces disease incidence, severity, and yield loss
Crop rotation	Rotate maize with non-host crops such as haricot bean, soybean, common bean, or other legumes for 1–2 seasons	Reduces pathogen survival in crop residues
Residue management	Remove, bury, or incorporate infected maize residues after harvest	Lowers the primary source of inoculum
Timely planting	Plant at the recommended planting period for the locality	Reduces exposure to favorable conditions for disease development
Optimum plant spacing	Maintain recommended plant population and spacing	Improves air circulation and reduces leaf wetness
Balanced fertilizer application	Apply recommended rates of nitrogen and phosphorus based on local recommendations	Enhances plant vigor and tolerance to disease
Field sanitation	Remove volunteer maize plants and control weeds	Minimizes alternative sources of inoculum
Regular field scouting	Monitor fields from the early vegetative stage until grain filling	Enables early detection and timely management
Fungicide application	Apply recommended fungicides (e.g., azoxystrobin, propiconazole, tebuconazole, or their mixtures) when disease reaches the economic threshold	Suppresses disease development and protects grain yield
Integrated Disease Management (IDM)	Combine resistant varieties, crop rotation, residue management, monitoring, and fungicide use when necessary	Provides sustainable and effective long-term disease control

Source: Compiled and synthesized from [5, 8-12, 15, 16].

4. Discussion

Northern Leaf Blight (NLB), caused by *Exserohilum turcicum* (Pass.) Leonard and Suggs, is widely distributed across the major maize-producing zones of Southern Ethiopia, including Wolaita, Sidama, Gamo, Gofa, Gedeo, Konso, Derashe, Ari, and South Omo. The widespread occurrence of the disease is primarily associated with favorable environmental conditions, including moderate temperatures, high relative humidity, frequent rainfall, and prolonged periods of leaf wetness that promote pathogen infection, sporulation, and disease epidemics. Morphological, cultural, and pathogenic variability among Ethiopian *E. turcicum* isolates indicates the existence of diverse pathogen populations capable of adapting to different agro ecological conditions and host genotypes, thereby contributing to disease persistence and severity across maize-growing regions [11]. Likewise, nationwide disease surveys have demonstrated that altitude, rainfall, temperature, and humidity are major determinants of the spatial and temporal distribution of Northern Leaf Blight epidemics in Ethiopia [12]. Continuous maize cultivation, limited crop rotation, the retention of infected crop residues, and the widespread cultivation of susceptible maize varieties further increase inoculum survival and disease pressure in subsequent cropping seasons [13]. Consequently, severe NLB epidemics substantially reduce the photo synthetically active leaf area, accelerate premature leaf senescence, impair grain filling, and may result in grain yield losses ranging from 15% to more than 50% under favorable environmental conditions [14].

The present review further confirms that the variation in disease incidence, severity, and yield loss observed among the maize-growing zones of Southern Ethiopia is closely associated with differences in host resistance, environmental conditions, and crop management practices. Field evaluations conducted in Ethiopia have shown significant differences among maize genotypes in their resistance to Northern Leaf Blight, demonstrating that the deployment of resistant varieties is one of the most effective and economically sustainable disease management strategies [15]. In addition to host resistance, integrated disease management practices, including crop rotation, destruction of infected residues, timely planting, balanced fertilizer application, regular field scouting, and fungicide application when economically justified, are essential for reducing disease incidence and minimizing yield losses [16]. Recent studies have further emphasized that integrated management strategies should be supported by continuous disease surveillance and agro ecological risk assessment to improve the timing and effectiveness of disease control interventions [18]. Surveys conducted in western Ethiopia also confirmed that disease prevalence is strongly influenced by continuous maize production systems and favorable climatic conditions, highlighting the importance of combining resistant cultivars with sound agronomic practices [20]. Overall, integrating host resistance, cultural practices, disease monitoring, and judicious fungicide use provides the most sustainable approach for managing Northern Leaf Blight and improving maize productivity in Southern Ethiopia [11-20].

5. Conclusion

Northern Leaf Blight is one of the most important foliar diseases affecting maize production in Southern Ethiopia. The disease is widely distributed across major maize-growing zones such as Wolaita, Gamo, Gofa, Gedeo, Ari, and South Omo, where environmental conditions such as moderate temperatures, high humidity, and prolonged leaf wetness strongly favor its development. The disease significantly reduces photosynthetic leaf area, resulting in yield reduction and poor grain quality, particularly when susceptible varieties are grown under conducive environmental conditions.

The review highlights that disease incidence and severity are strongly influenced by environmental factors, altitude, cropping systems, and the availability of resistant maize varieties. In many farming systems, continuous maize cultivation, limited crop rotation, and poor residue management have contributed to increased disease pressure. Although several management strategies exist, including resistant varieties, cultural practices, chemical control, and integrated disease management, their effectiveness is often limited by low adoption and limited farmer awareness.

Overall, Northern Leaf Blight remains a persistent and economically important constraint to maize production in Southern Ethiopia. Its impact is likely to increase unless integrated and sustainable management strategies are widely developed and effectively implemented across all major maize-growing agro ecological zones.

6. Recommendations

Based on the findings of this review, the following recommendations are forwarded:

Strengthening the development and dissemination of high-yielding and disease-resistant maize varieties suitable for different agroecologist of Southern Ethiopia.

Promoting integrated disease management (IDM) practices that combine resistant varieties, crop rotation, residue management, timely planting, and judicious fungicide use.

Enhancing farmer awareness and extension services to improve early disease identification and proper management practices.

Encouraging crop diversification and rotation systems to reduce inoculum build-up in maize-based farming systems.

Strengthening research on pathogen variability, epidemiology, and climate change impacts on Northern Leaf Blight development.

Improving disease surveillance and monitoring systems at regional and zonal levels for timely intervention.

Abbreviation

NLB	Northern Leaf Blight
E. turcicum	Exserohilum turcicum
IDM	Integrated Disease Management
AUDPC	Area Under Disease Progress Curve
FAO	Food and Agriculture Organization
CIMMYT	International Maize and Wheat Improvement Center
ha	Hectare
%	Percentage
RH	Relative Humidity
DAS	Days After Sowing
ANOVA	Analysis of Variance
LSD	Least Significant Difference
SE	Southern Ethiopia
EIAR	Ethiopian Institute of Agricultural Research
MoA	Ministry of Agriculture

Author Contributions

Daniel Abebe: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Validation, Visualization, Writing – original draft

Damtew Atnafu: Resources, Supervision, Writing, review & editing

Conflicts of Interest

The authors declare that no conflict of interest.

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