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Research Article

Status of Coffee Leaf Rust Diseases in Coffee (*Coffea arabica L.*) Growing Areas of Guji Zone

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Abstract

In Ethiopia, coffee represents the most important agricultural commodity, contributing 34% of the total export and 39% of agricultural commodities export earnings in the country. CLR disease was remarkably increasing from time to time. The aim of the study was to generate baseline information on the status of CLR diseases to design appropriate management options. The survey was conducted in two districts of Guji zone, including Adola Rede and Odo Shakiso in 2021. A total of 30 coffee farms were used for the study. Then, the presence or absence and volumes of the diseases were determined as incidence and severity, respectively. The results of the present study revealed that Mean incidence and severity of CLR ranged between 74.67% to 77.33% and 33.17% to 39.24% in Odo Shakiso and Adola Rede district, respectively. The overall incidence and severity were 76.6% and 36.2%, respectively. There was a negative correlation between altitude and CLR incidence (r = -0.47) and severity (r = -0.48). CLR were observed as the major coffee diseases and highly distributed in the study area. Therefore, it is recommended to develop and introduce resistant coffee varieties in the study area. Additionally, it is crucial to provide training for farmers on implementing key cultural practices.

Keywords: Coffee; Coffee leaf rust; Incidence; Severity

Introduction

Coffee (*Coffea arabica* L) is originated in Ethiopia and the second largest commodity traded next to oil in the world and plays a great role to balance trade between developed and developing countries [7]. In Ethiopia, coffee represents the most important agricultural commodity contributing 34% of total export and 39% of agricultural commodities export earnings in Ethiopia [3].

In Ethiopia, coffee produced in 794,403.50 hectare of land and 5,455,663.58 quintals of produce and 6.87 yields (qt/hectare) were obtained in 2021/22 [4]. Ethiopia is the one major producer and consumers of high value coffee, and ranked third-largest grower of arabica coffee from the world and the biggest producer overall in Africa [5].

Coffee berry disease, coffee wilt disease and coffee leaf rust diseases are the three major coffee diseases affecting coffee production in Ethiopia [3,8,9]. Among the fungal disease coffee leaf rust is the most important coffee disease globally with a worldwide distribution [11]. Coffee Leaf Rust (CLR) is one of the most important diseases of *C. arabica* in the world [15]. Coffee Leaf Rust (CLR) is a major disease which greatly limits arabica coffee (*Coffea arabica* L) production in almost all growing countries around the world [13]. CLR was first reported in Ethiopia in 1934 (Sylvian, 1955). The prevalence of CLR is currently increasing in Ethiopia; percentage of infected trees increased from 12.9% in 2000 year to 36.0% in 2010 (Zeru *et al*. 2012). CLR was widely distributed in most assessed districts of Sidama and Gedeo zones of Southern Ethiopia. CLR disease was remarkably increasing from time to time in all assessed coffee farms [1]. CLR was also economically important coffee disease in Harerghe of eastern Ethiopia with the incidence of 83% [12]. CLR can cause yield losses in excess of 75% where outbreaks are severe [15].

Guji Zone has suitable agro ecology for Coffee production and productivity. It producing sustainably and supplying organic coffee to the national and international market. In the zone coffee leaf rust was hindering the production as well as the productivity of coffee. However, there is lack information related to the prevalence, incidence and its severity of coffee leaf rust disease. So, the aim of the study was to generate base line information on coffee diseases status to design appropriate management options for the study areas.

Materials and Methods

Description of the Study Area

The assessment was conducted in 2021 in the major coffee-

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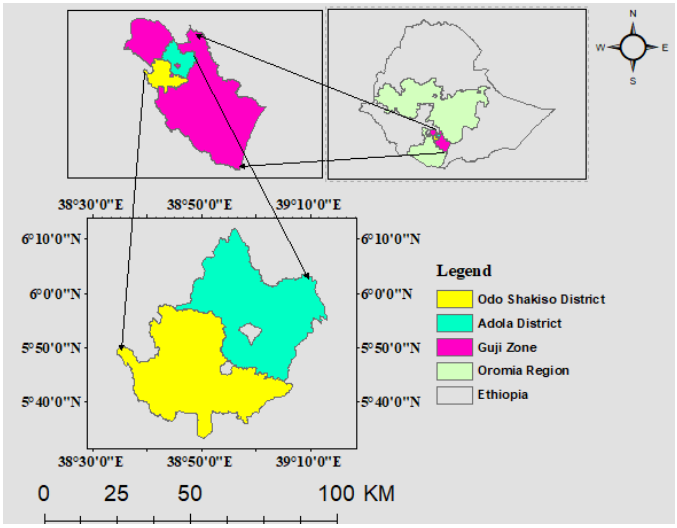

Figure 1: Map of the study areas of Guji Zone.

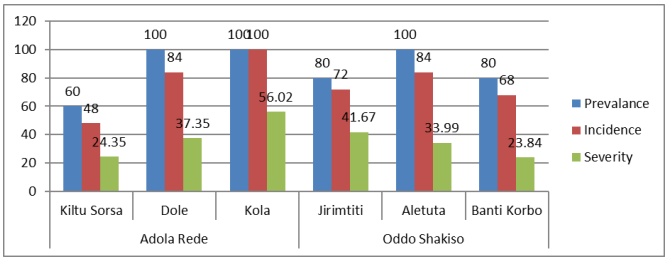

Figure 2: Coffee leaf rust Prevalence, incidence and severity in the PAs of two districts of Guji zone during 2021.

producing districts of Guji Zone (Adola Rede and Odo Shakiso) of the Southern Oromia Regional State, Ethiopia (Figure 1). The districts were selected based on their production potential. The coffee farms in the study area were located in the midlands and lowlands agro ecologies.

Sampling Techniques

From the above-mentioned districts, three PAs were selected through discussion with district coffee experts and DAs of those PAs, mainly based on coffee production potential and representativeness. Then, five coffee farms at a distance of 3-5 km were selected randomly for the study. A total of 30 coffee farms were used for the study. And during the disease assessment, other information was recorded, such as the age of the coffee, types of cultivar, management history, elevation of the area, and coffee production system.

Assessment of Coffee Leaf Rust

Disease prevalence*:* Disease prevalence was computed by dividing the number of infected farms by the total number of assessed farms in a PAs * by one hundred (100).

$$\text{Prevalence of CLR}(\%) = \frac{\text{No of infected farms}}{\text{Tolal No of Accessed farms}} * 100$$

Disease incidence: An assessment of coffee leaf rust incidence was conducted on five-ten (5–10) randomly selected coffee trees per farm by moving X. And then disease incidence was calculated using the following formula:

$$\text{Incidence of CLR (\%)} = \frac{\textit{Total number of diseased trees}}{\text{Total number of observed trees}} * 100$$

Disease severity: Each of the 5–10 selected trees was classified into three strata of branches (top, middle, and bottom). From each stratum, two branches were selected to record disease severity. Then, disease-damaged and healthy leaves were counted and calculated as follows:

$$\text{Severity of CLR (\%)} = \frac{\textit{Total number of diseased leaves}}{\text{Total number of observed leaves}} * 100$$

Data Analysis

All data collected from the field was subjected to computerization and managed using an Excel Spread Data Sheet. Then, finally, the managed data was analyzed using R software.

Results and Discussion

Occurrence of Coffee Leaf Rust in Guji zone

During this assessment, CLR was observed as a major disease in the coffee production districts of the study area. The incidence and severity of the diseases varied among and within PAs and districts.

Prevalence, Incidence and Severity of Coffee Leaf Rust

Prevalence: The mean prevalence values of the assessed PAs were 60% to 100% in Adoloa Rede District, with a mean of 86.67%. And 80% to 100% in Odo Shakiso District, with a mean of 86.67%, respectively (Table 2). The overall mean prevalence was 86.67%. A similar result reported by Garedew *et al*., [6] showed that CLR prevalence was higher (60.17%–75.5%) in the Ageyo-Smeta areas of southwest Ethiopia during their study period (2013–2015).

Table 1: Geographical location of the study districts of Guji zone during 2021.

Districts	Latitude Range	Longitude range
Adola Rede	5˚50'0''- 6˚10'0''	44˚50'0'' -45˚10'0''
Odo Shakiso	5˚20'0''-6˚0'0'	44˚40'0''-45˚20'0''

Table 2: Coffee leaf rust Prevalence, incidence and severity in two districts of Guji zone during 2021.

Districts	Altitude Range	Coffee leaf rust		
		Prevalence %	Incidence %	Severity %
Adola Rede	1440-1815	86.67	77.33	39.24
Odo Shakiso	1659-1782	86.67	74.67	33.17
Mean		86.67	76	36.2

Table 3: Correlation of CLR intensity with Attitude.

	Incidence	Severity	Altitude
Incidence	1	0.75***	-0.47**
Severity		1	-0.48**
Altitude			1

Incidence and Severity

In all assessed coffee farms, rust incidence and severity were visually observed. The mean value of coffee leaf rust incidence was 77.33% in Adola Rede and 74.67% in Odo Shakiso district (Table 2). The CLR mean incidence values of PAs varied from 48% to 100%. The maximum CLR incidence of 100% was recorded at Kola PAs of Adola Rede district, followed by Aletuta and Dole (84%), while the lowest incidence was recorded at Kiltu Sorsa (48%) (Figure 2).

The mean value of coffee leaf rust severity was 39.24% in Adola Rede and 33.17% in Odo Shakiso district (Table 2). The mean severity values of CLR in the study PAs varied from 23.84% to 56.02%. The maximum CLR severity (56.02%) was recorded at Kola PAs of Adola Rede district, followed by Jirimtiti (41.67%) and Dole (37.35%), while the lowest severity was recorded at Bati Korbo (23.84). The overall mean incidence and severity were 76% and 36.2%, respectively. Similar reports by Ano *et al*., [1] showed that the highest CLR incidence and severity were 38.62% and 13.80%, while the lowest were 10.52% and 1.38% at Dilla Zuria and Yerga Chaffee district, respectively. [12] re-

ported that the mean incidence of CLR ranged between 73.11% at Bedeno and 98.52% at Boke, whereas the severity of the disease varied between 32.22% and 67.11% at Bedeno and Boke respectively.

The result of the survey indicated that the incidence and severity of CLR in the study area varied from PA to PA and from district to district. The variation in disease distribution (incidence and severity) might be due to variations in variety compositions, production systems, management practices, and environmental conditions in the study areas. According to Avelino [2], intensive production systems contribute to variations in rust intensity with coffee management practices.

Correlation between CLR Intensity and Altitude

There was a highly significant ($p < 0.01$) and negative correlation between altitude and incidence ($r = -0.47$) and severity ($r = -0.48$) (Table 3) of CLR, indicating that the lower altitudes are more favorable for CLR occurrence than higher elevations. Disease incidence and severity increased as altitude decreased. During this assessment, the highest (100%) mean incidence of CLR was recorded in the lowlands of Kola PAs, and the lowest (48%) was recorded in the midlands of Kiltu Sorsa PAs. Similarly, the highest (56.02%) mean severity of CLR was recorded in the lowlands of Kola PAs, and the lowest (23%) was recorded in the midlands of Banti Korbo PAs. A similar report by Samuel *et al*., (2020) showed that the highest incidence and severity were recorded in the lowlands compared to the midlands and highlands agro ecologies. CLR incidence and severity increase with decreasing altitude [1].

Conclusion and Recommendation

In conclusion, the assessment revealed the significant impact of Coffee Leaf Rust (CLR) on coffee production within the Guji zone. CLR exhibited high prevalence, incidence, and severity across the surveyed districts, with variability observed between districts and even within PAs. The negative correlation between CLR intensity and altitude suggests the influence of environmental factors on disease dynamics. The CLR high distribution across study districts highlights its potential threat to coffee production.

Therefore, it is recommended to develop and introduce resistant coffee varieties and distribute them to farmers in the study area. Additionally, it is crucial to provide training for farmers on implementing key cultural practices. These measures are essential for effectively managing disease intensity levels in the region.

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