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Distribution and Intensity of Coffee Berry Diseases (*Colletotrichum Kahawae* Waller and Bridge) in Gurage Zone

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Abstract: In worldwide more than 125 million people and in Ethiopia around 15-16 million peoples were derive their income from Coffee. Coffee berry disease (CBD), coffee wilt disease (CLD) and coffee leaf rust (CLR) are most important coffee diseases in Ethiopia. Previous research works have little information on CBD distribution, status and associated factors in Gurage zone southern parts of Ethiopia. This study was designed to carry out the CBD disease intensity. The assessment was done in Enemorina Ener, Ezha and Cheha districts of Gurage zone during July to August 2017. The study result indicated that CBD was prevalent in all inspected farmers' field with a disease incidence range of 100% and 86.66%. Percent Severity Index was recorded from 38.89 to 59.44% in all assessed areas. Pearson correlation analysis showed that disease incidence (DI) and percent severity index (PSI) have positive and strong relationship with altitude (r=0.46) and (r=0.73), respectively. It is good when the study was repeated in one more production year and with including other coffee producing districts of Gurage zone. The present study gives clues to generate CBD disease management strategies as short term and develop resistant cultivars for the study area as long term strategy to increase county foreign currency.

Keywords: Arabica Coffee; Coffee berry disease; Disease Incidence; Percent Severity Index; Gurage coffee Accessions.

Research Paper

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1. INTRODUCTION

The genus Coffea has more 100 species, but *Coffee* arabica L. and C. canephora P. are commercially cultivated species (Davis *et al.,* 2012). In worldwide more than 125 million people were deriving their income from Coffee industry (Lashermes *et al.,* 2012). The origin and genetic diversity of Arabica coffee is found in Ethiopia. In Ethiopia around 15-16 million people were involved coffee production for their income. It also contributes about 10% of crop production and 34% of foreign exchange in the county (Tadesse *et al.,* 2015; Tefera, 2015; ICO, 2018).

About 449,229.81 tons of coffee were produced with an average yield of 0.619 tons/ha in 725,961.24 ha of land at 2017/18 production year in Ethiopia. This production shares 5.09% area under production with total crop produced in the country (CSA, 2018). Oromia and Southern Nations Nationalities and People Regions (SNNPR) are potential coffee producing regions, 95% coffee produced by small holder farmers in Ethiopia. Gurage zone is one of the potential coffee growing areas of SNNPR region. In 2016/17 production year the zone produced 836.68 tons from 3934.27ha of land with average yield of 0.213 tons per ha (GZADD, 2017; CSA, 2017). This production 1.81 percent shares in the region and 0.56 percent of in the country (CSA, 2017).

Most important coffee diseases in Ethiopia were coffee berry disease (Colletotrichum kahawae), coffee wilt disease (Gibberella xylarioides) and coffee leaf rust (Hemileia vastatrix) (Hindorf, 1998; Girma *et al.,* 2009; Abdi and Abu, 2015). Different scholars have reported the intensity of CBD diseases in different areas of Ethiopia. The research done in 1997 and 1998 in Oromia region indicated that 31% and 32 % disease severity for the respective years (Melaku and Samuel, 2000). The report of Tesfaye and Sinedu (2000) reflected that 40% mean CBD incidence with 22.8% of mean CBD severity in 31 districts of SNNPR, respectively. The survey conducted in 22 districts at Oromia and SNNPR region recorded 70.7% CBD incidence in Hararghe, 65.3% in Gedeo and 59.3% in Jimma with correspondingly with severity of 42.7, 46.7 and 32.0%, respectively (Kumlachew *et al.,* 2016). However, coffee research in the country have little research and report related to distribution and intensity

of CBD in Gurage zone. Thus, this study was conducted to assess the distribution and status of coffee berry disease in Gurage zone of major coffee producing districts.

2. MATERIALS AND METHODS

2.1 Description of the Study Area

The assessment of CBD was done in July to August 2017. The disease intensity assessments were done in Gurage Zone of Cheha, Enemorina Ener and Ezha districts which are major coffee producing districts of the area (**Fig. 1**). The zone is located in 7.8^0-8.5^o latitude and 37.5^o-38.7^o longitude, which have high land, midland and low land agro ecologies with 28.3%, 64.9% and 6.8% percent share. The zone has 1000-3500 m-a-s-l altitude range with average rainfall 1350-1800 mm and mean minimum (11^oC) and maximum temperature (30^oC) (GZADD, 2017).

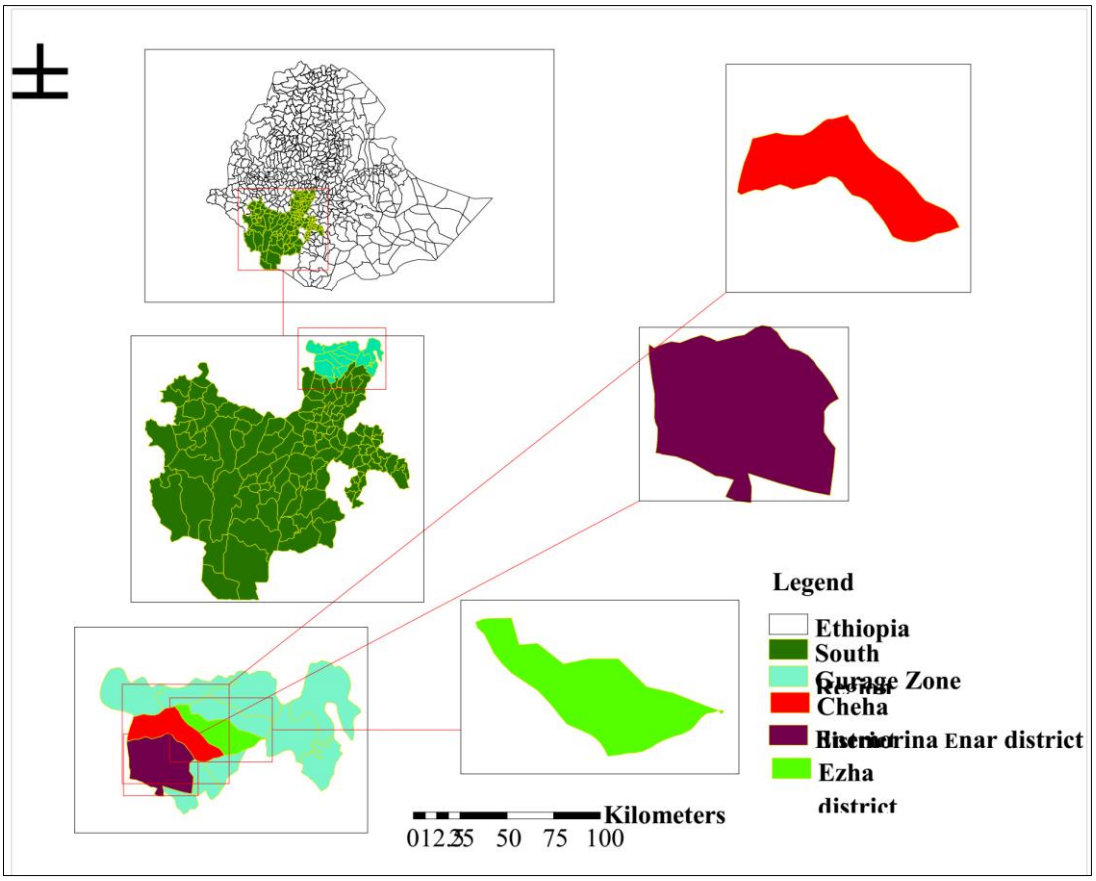

Figure 1: Maps of Gurage zone with three major coffee producing districts

2.2 Disease Data Assessment

CBD disease assessment was conducted in Cheha, Enemorina Enar and Ezha districts of Gurage Zone. The districts and peasant associations were purposively selected by its coffee production potential, in each districts 2-3 km interval with accessible main and rural road, the farmers coffee fields were randomly selected. Thirty three farmers' fields as a total were assessed in the disease survey; 3 farmer fields for Cheha and Enemorina Enar and 5 coffee fields for Ezha districts were inspected. Farmer fields were diagonally assessed for disease assessment by following Tesfaye and Ibrahim (2000) procedures. CBD disease intensity was done by following the procedure of Van der Graaff (1981).

(a) Prevalence

Presence and absence of CBD were inspected visually each selected farms and the prevalence were calculate by this formula

$$\textbf{Prevalence} = \frac{\text{Number of infected farms}}{\text{Total number of assessed farms}} \times 100$$

(b) CBD Disease Incidence

From each field, ten coffee plants were randomly selected for the presence or absence of CBD in each plant and then disease incidence were calculated by

$$\textbf{Incidence} = \frac{\text{Number of infected trees}}{\text{Total number of trees assessed in the farm}} \times 100$$

(c) Disease Severity (DS)

From each farmer' field ten coffee trees were randomly taken and each tree was divided into top, middle and

bottom strata. One middle branch was taken from each stratum and count the number of diseased and healthy berries in that branch and then DS was calculated buy:

$$\textbf{Disease Severity} = \frac{\text{Number of damaged berries}}{\text{Total number of berries counted}} \times 100$$

Disease severity scales rate where, 0: 0%, 1: ≤2%, 2: 2-5%, 3: 6-10%, 4: 11-50%, 5: 51- 99%, and 6: ≥99% of diseased berries was converted to Percentage Severity Index (PSI) (Wheeler, 1969; Abdi and Abu, 2015).

$$\textbf{PSI} = \frac{\text{Sum of numerical rating}}{\text{Total number of rated plant X max. score of the scale}} \times 100$$

During the survey the type of coffee production system; the variety planted; altitude; shade tree used; the age of the plant and agronomic practice used by farmers were recorded.

Before data analysis; the collected data were summarized, normality test were checked for normal distribution. The diseases intensity data were analyzed by using SAS program version 9.3 software (SAS, 2011). Pearson correlation analysis was used for compare the relationships of disease intensity and altitudes by using the SAS software (Proc procedure). Graphs were drawn by using Excel microcomputer statistical software.

3. RESULTS AND DISCUSSION

CBD diseases were prevalent (100%) in all the inspected farmers' fields in Gurage zone of major coffee growing areas (**Fig. 2**). The disease intensity was different among and within the assessed three districts. Coffee berry incidence and percent severity index were significant different (p <0.05) among peasant associations of the three districts. The highest disease incidence was scored in Bortena peasant associations (100%), which was statistically different from Sisenaematye and Darecha but not significantly different from other peasant associations. On the other hand, lower CBD incidence was scored in Sisenaematye peasant associations, but not statistically different from all peasant associations except Bortena (**Fig. 2**). Mean CBD disease incidence was very high in all peasant associations that range from 86.66 to 100%.

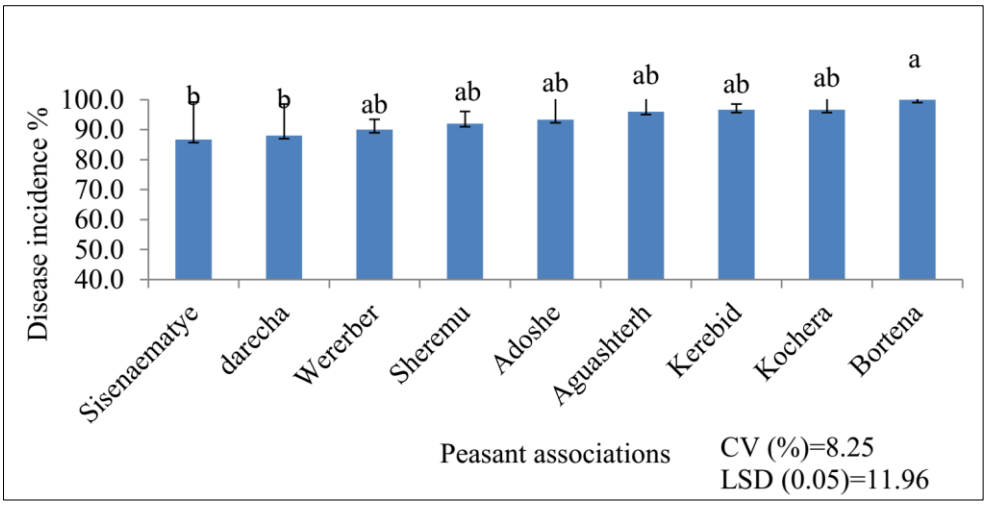

Figure 2: Mean Coffee Berry Diseases incidence in nine peasant associations of Gurage zone.
Means with the same letters are not statistically different at LSD 0.05%

Percent severity index was statistically significant difference (p<0.05) between peasant associations of the three districts. The highest mean PSI was scored at Kochere (59.44%) in Enemorina Ener districts, which was not statistically significant difference from all peasant associations except Sisenaematye and Darecha (**Fig. 3**). On the hand, the lower mean PSI was recorded in Sisenaematye (38.89%) which was not statistically significant different from Aguashterh, Wererber and Darecha peasant associations and statistically significant difference among Sheremu, Adoshe, Kerebid, Bortena and Kochera peasant associations (**Fig. 3**).

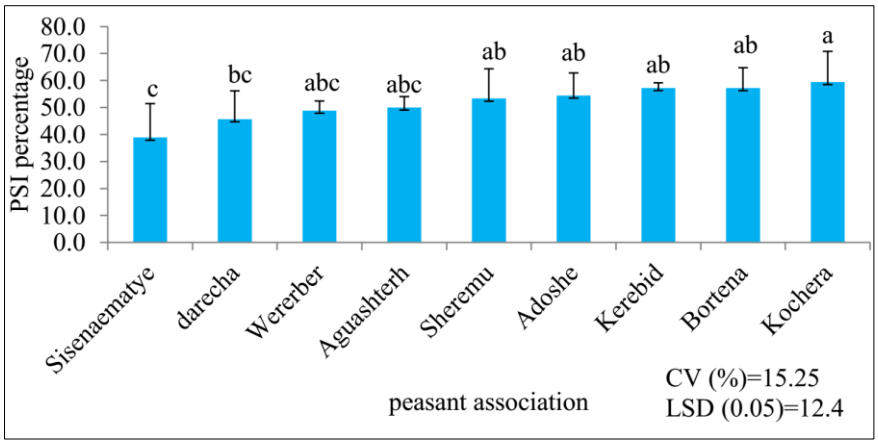

Figure 3: Mean Percent severity index of nine peasant associations of Gurage zone.
Means with the same letters are not statistically different at LSD 0.05%

In the surveyed area all the farms were in home garden which were garden coffee productions system and intercropped with Enset. Hoeing of the farm and adding animal manure were agronomic practices used in the study area for weed management and nutrients for intercropping crop.

The study result indicated that 93.26% mean CBD disease incidence and 51.68% mean percent severity index was recorded across the assessed districts. However, at district level DI reached up to 100% in Enemorina Ener at Bortena peasant associations and also PSI reached 59.44% in the same district at Kochera peasant association (**Fig. 4**). Enemorina Ener districts have high disease pressure for both disease incidence and PSI as compare to the other two districts. The survey result showed that the two disease intensity different from district to district and also between peasant to peasant associations. This variation probably linked to the presence of diverse coffee genetic resources, different conducive environmental conditions and virulence difference of CBD pathogens. In this study, almost all farmers field on assessed areas were planted a local coffee accessions, which are known as susceptibility to CBD and low yield. Climate changes can favor CBD disease development by predisposing the coffee plants to increased amount and duration of rainfall, reducing temperature and the likes (Kifle and Demelash 2015).

Enmorina Ener districts records highest disease intensity compare to the other districts, this should be the local coffee accessions bear much higher berry than the other districts, the berry load may increase the disease intensity of the coffee (Vaast *et al*., 2005). These district is found in higher altitude areas (above 1950) compare to the other districts, where favorable environmental conditions are found for CBD development and also, the age of local coffee accessions in that district was higher than the other districts (above 20).

Generally, the present study showed that the existence of the high CBD disease intensity in surveyed area was due to the farmers used local coffee cultivars, which is susceptible to the diseases. This study was supported by Tesfaye and Sinedu, (2000) reports that 75% disease incidence and 28 - 43% severity in Gurage zone, which was the disease pressure was high.

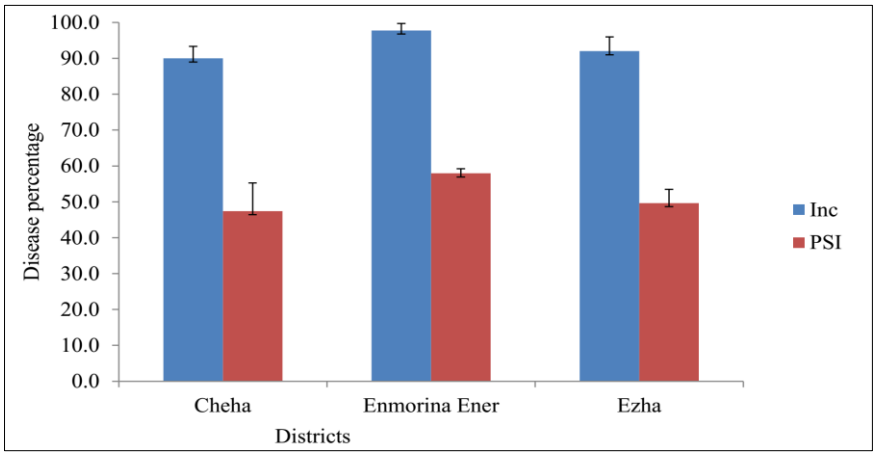

Figure 4: Mean CBD incidence and Percent severity index of three Gurage districts.

Pearson correlation analysis showed that highly significant ($p < 0.01$) and positive correlation between altitude with CBD disease incidence ($r= 0.46$) and Percent severity Index ($r = 0.73$), which indicate that altitude increases the disease intensity also increased (**Tab 1**). The highest disease incidence (100.0%) and percent severity index (63.3%) was recorded in altitude range of 2006-2025 m-a-s-l. In high altitude areas there is low temperature; high rainfall, high humidity or wetness with including susceptible coffee cultivar that favor CBD disease development (Cook 1975; Kagezi *et al*., 2018). On the other hand, there is positive and weak relationship between age of the plant and PSI (*r=0.31*), but negative and non-significant effect on disease incidence (**Tab.1**). The present study result indicated that high disease pressure was observed in study area, which can cause high yield loss (100%) when appropriate control measures were not taken.

Table 1: Pearson correlation analysis of CBD disease and associated factors in Gurage zone

	Age	DI	Alt	PSI
Age	1.00	-0.07ns	0.27ns	0.31*
DI		1.00	0.46***	0.73***
Alt			1.00	0.60***
PSI				1.00

Notes: Where DI= disease incidence, Alt= altitude, PSI= percent severity index, *, *** significant level at $p<0.05$ and $p<0.001$, respectively ns = non-significant

4. SUMMARY AND CONCLUSION

In worldwide coffee was most important crop that grown 80 countries and Ethiopia is first export in Africa and fifth in the world. Coffee berry disease is one of important coffee disease in Ethiopia. The present study was done to record the intensity of CBD diseases in Cheha, Ezha and Enemorina Ener district of Gurage zone. The study indicated that CBD was prevalent in all peasant associations of the three districts with varied disease incidence and Percent severity index. This variation of disease intensity between districts and peasant association may be due to pathogen virulence variability, diverse genetics resource of coffee accessions and environmental condition of the area. Mean CBD disease incidence range from 86.66 to 100% whereas mean PSI ranges from 38.89 to 59.44%. Pearson correlations analysis indicated that DI and PSI have positive and strong relationship with altitude. It is better to repeat this study in one more season and including other coffee producing districts. The present study gives us clues to generate CBD disease management strategies as short term and develop resistant cultivars for the study area as long term strategy to increase counters' foreign currency.

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