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Status of Major Coffee (*Coffea arabica* L.) Diseases in Major Coffee Growing Areas of Eastern Ethiopia

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Introduction

- Coffee is an important commodities produced primarily for consumption as a beverage by more than 1/3 of the world's population in 80 world countries.
- In Ethiopia, it is a single commodity provides a source of revenue for millions of people.
- The wide climatic and soil factors offer the country to birth place of Arabica coffee which accounts for 80% of the world coffee.
- Despite its largest share in export and economic contribution, several constraints that can affect the its production and utilisation have been mentioned

Introduction ...Cont'd

- Of these constraints, perennial coffee diseases pressures are the most serious issue which confronting Ethiopian's coffee production and calls for immediate control measures.
- Major disease that occurred because of climate variation during coffee growing will increase disease prevalence and a home for newly outbreak disease.
- The region known as Hararghe comprises the eastern most of the specialty coffee growing zones of Ethiopia (Ameyu, 2017).

Introduction ...Cont'd

- In Hararghe, an increase in temperature threatens the coffee at an alarming rate and is become more conducive, for disease prevalence (Iscaro, 2014).
- As climate change becomes increasingly severe, and thus an assessment of the status of coffee disease could be valuable to those hoping to create adaptation strategies and policies (Battiste *et al.*, 2016).
- Significant proportion of potential coffee yields are annually lost due to persistent disease problems.

Introduction ...cont'd

- Previously the major coffee diseases in Ethiopia are CBD and CWD, but currently CLR and branch dieback (BDB) are becomes others economically important coffee problems particularly in Hararghe areas.
- Therefore in the area CBD, CLR, CWD and BDB became a big threat for Hararghe coffee production.
- Recent study showed that, the loss of up to 53-100% of the coffee yield loss was observed due to above mentioned diseases in some individual Hararghe coffee producing farms (Biratu 1998).

Introduction ...Cont'd

- Therefore; there was a need to ascertain the current incidence & spread of those diseases in Hararghe areas.
- To this end, the extensive survey of major coffee diseases in major coffee growing areas of West & East Hararghe zones was conducted for the objective:
 - ✓ to document the incidence and severity of the major coffee diseases in different Hararghe coffee producing agro-ecologies there by recommend the possible intervention required.

Materials & Methods

- An assessment was conducted in 4 districts (D/Labu, Habro, Boke & Bedeno) from August-September 2015.
- The districts were selected based on their coffee production potential, and categorized into 3 coffee growing agro-ecology (highland, midland & lowland).
- From each agro-ecology 4 representative coffee farms with approximately similar age of coffee trees were selected at the interval of 3-5 km.
- Finally a total of 12 farms sample per district were assessed for the diseases infection studies.

Materials & Methods ...Cont'd

- At each farm, a questionnaire was administered and the owner was interviewed about the age of the tree, type of coffee species and history of disease.
- The fields were observed for farming practice applied (weed control method and shade tree condition) and other factors that contribute in occurrence, distribution and severity of the diseases.
- Geographical information such as altitude, longitude & latitude of each farm was recorded, using GPS at a central point per farm surveyed.

Methods of disease data collection

1. CBD, CWD and BDB incidence assessment

- 50 trees were observed on a diagonal line across the farm for the presence or absence of disease symptoms.
- Then the incidences of the disease were measured by counting infected number of mother trees over the total number of observed trees as follows:

$$\text{Incidence (\%)} = \frac{\text{Total infected tree}}{\text{Total observed tree}} \times 100$$

2 CBD and BDB severity assessment

- 10 trees with uniform age were systematically selected at a distance of 6-8m within the farm.
- Each tree classified into three strata of branches (top, middle and bottom).
- From each stratum 2 branches were selected and the disease damaged and healthy berries/branches were counted and then severity was computed as follows:

$$\text{Severity (\%)} = \frac{\text{Total infected berries/branches}}{\text{Total ocouted berries/branches}} \times 100$$

3. CLR incidence, severity & SLD assessment

- 10 coffee tree were randomly selected per farm and three 3 pairs of branches representing upper, middle and lower canopy layers of the coffee plant were selected.
- Rust incidence expressed in percentage was determined as the number of diseased leaves per branch.
- 60 pairs of leave per farm were collected in plastic bags and severity and SLD data were recorded.
- Rust severity was measured as the proportion of leaf area rusted using diagrammatic scale 1%, 3%, 5%, 7% and 10% of leaf area rusted.

- Then rust severity on the leaves were estimated by making a cumulative count of each sporulation lesion area (Kushalappa and Chaves,1980) (Figure 1).
- At the same time SLD was measured as number of sporulated lesions per infected leaves.

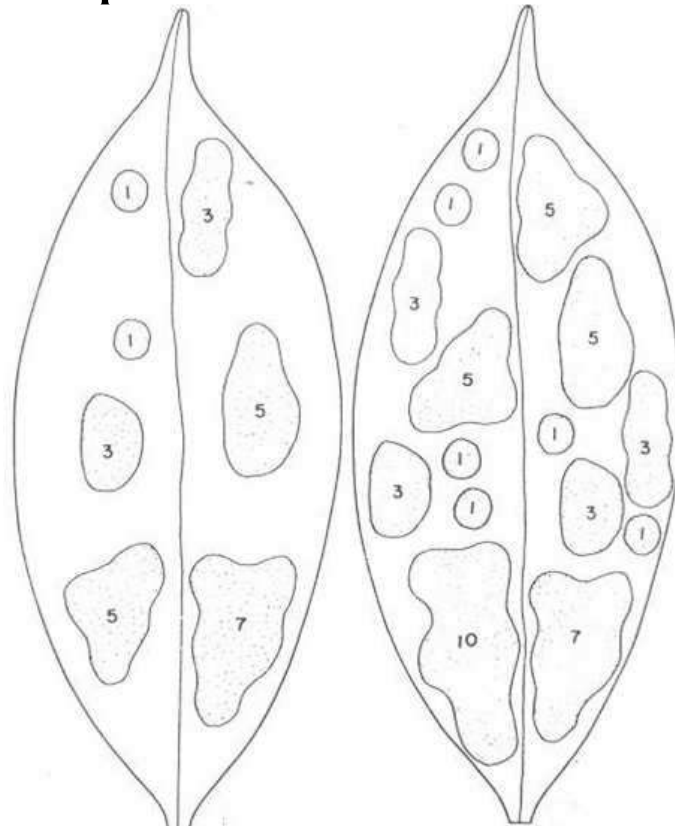


Figure 1. Assessment key for percent coffee leaf area rusted

Data analysis

- The data were summarized on excel spreadsheet software and the mean disease incidence, severity and SLD were computed.
- Also completed questionnaires were entered into Microsoft Excel spread sheets where variable codes were assigned.
- Data were then analyzed using Statistical Package for Social Sciences (SPSS).
- Disease infection were also tested for agro ecological variation, agronomic practice and shade type.

Results & Discussion

- Four coffee diseases CBD, CLR, CWD and BDB were found as major diseases problems in association with all coffee production districts.
- The result reveal that CLR and CBD and BDB were highly affecting the coffee through all observed field.
- Their incidence & severity were varied among & within Hararghe areas based on the agro-ecological conditions & production system of coffee.
- This shows the disease were causing considerable crop losses in the study areas

Disease incidence and severity

- The result showed that, CBD was very severe problem at the high land of Bedeno followed by Boke district, where as CLR was sever at Boke followed by lowland of Bedeno (Table 1).
- CWD infection was only observed at very low level to less than 3% with overall mean infection of 0.92% and ranges from 0-20% (Table 1).
- The mean incidence of CBD, CLR & BDB are 66%, 33% and 47%, respectively (Table 1).
- The variation of incidence and severity were observed among the agro-ecology (Table 2 and Figure 2-5).

Table 1. Mean Incidence of disease by Hararghe district

| District name | Incidence of diseases (%) | | | |
|----------------|---------------------------|---------|------|-------|
| | CBD | CLR | CWD | BDB |
| Daro Labu | 35.50 | 14.09 | 2.83 | 43.33 |
| Habro | 75.50 | 20.41 | 0.00 | 56.00 |
| Boke | 72.17 | 50.26 | 0.00 | 73.67 |
| Bedeno | 79.67 | 46.49 | 0.83 | 15.17 |
| Mean | 65.71 | 32.81 | 0.92 | 47.04 |
| Range | 0-100 | 0-74.82 | 0-20 | 0-100 |
| Std. Deviation | 27.52 | 25.23 | 3.74 | 29.66 |

CBD = coffee berry disease; CLR= Coffee leaf rust; CWD= coffee wilt disease; BDB= branch dieback

Table 2. Regional and ecological variation on the **Severity of coffee disease in Hararghe areas**

| District name | Severity of different diseases per agro-ecology (%) | | | | | | | | |
|---------------|---|---------|--------|---------|--------|--------|-----------|-----------|-----------|
| | Highland | | | Midland | | | Lowland | | |
| | CBD | CLR | BDB | CBD | CLR | BDB | CBD | CLR | BDB |
| D/Labu | 29.87 | 1.72 | 7.46 | 11.06 | 2.12 | 24.72 | 14.62 | 0.92 | 39.25 |
| Habro | 32.07 | 8.24 | 19.36 | 18.41 | 0.18 | 28.94 | 25.76 | 8.16 | 25.11 |
| Boke | 22.40 | 7.74 | 50.53 | 33.98 | 9.91 | 27.90 | 21.89 | 7.03 | 42.16 |
| Bedeno | 64.23 | 2.61 | 4.98 | 41.91 | 14.91 | 6.67 | 28.02 | 12.15 | 18.64 |
| Mean | 37.14 | 5.08 | 20.58 | 26.34 | 6.78 | 22.06 | 22.57 | 7.07 | 31.29 |
| Range | 0-86.8 | 0.02-17 | 0-56.5 | 0.23-65 | 0-19.3 | 0-48.2 | 0.2-35.97 | 0.25-18.8 | 3.37-74.1 |
| Std. Dev. | 24.14 | 5.01 | 19.64 | 15.81 | 6.91 | 15.15 | 9.52 | 5.98 | 21.60 |

CBD=Coffee berry disease; CLR=Coffee leaf rust; BDB=branch die back

Figure 2. CBD incidence across each-agro ecology per district

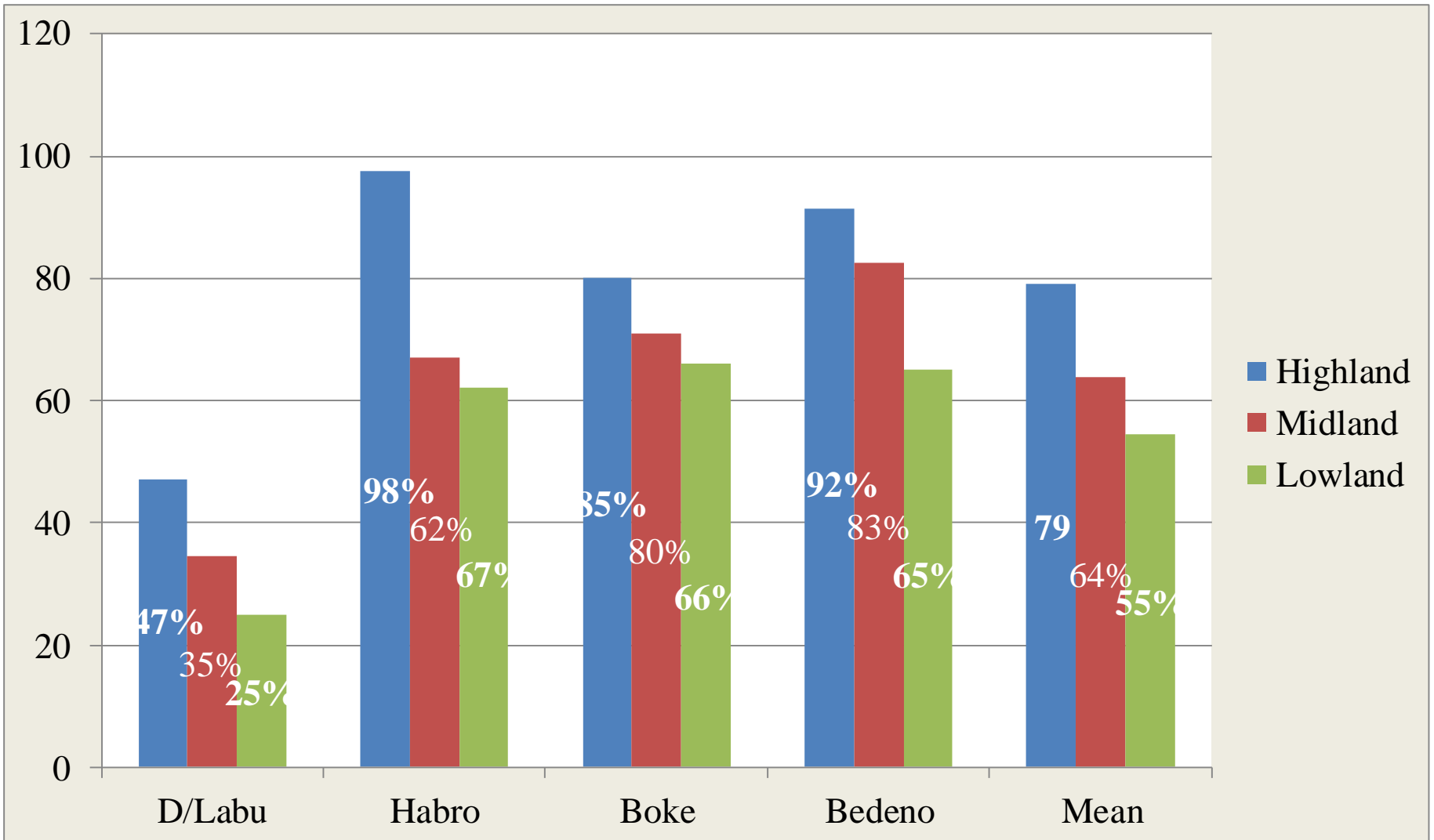


Figure 4. Incidence of CBD, CLR & BDB per coffee growing agro-ecologies of Hararghe areas

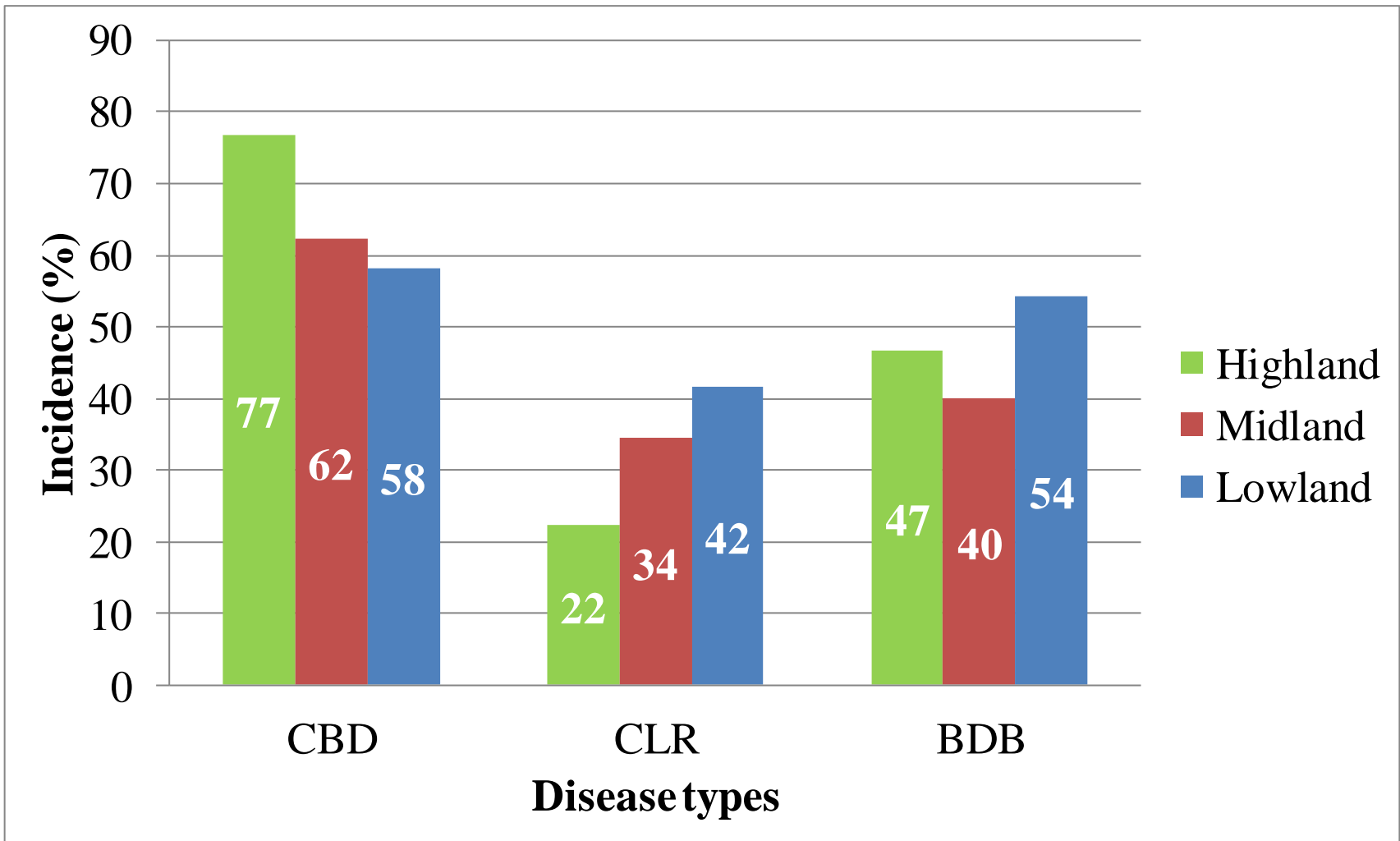
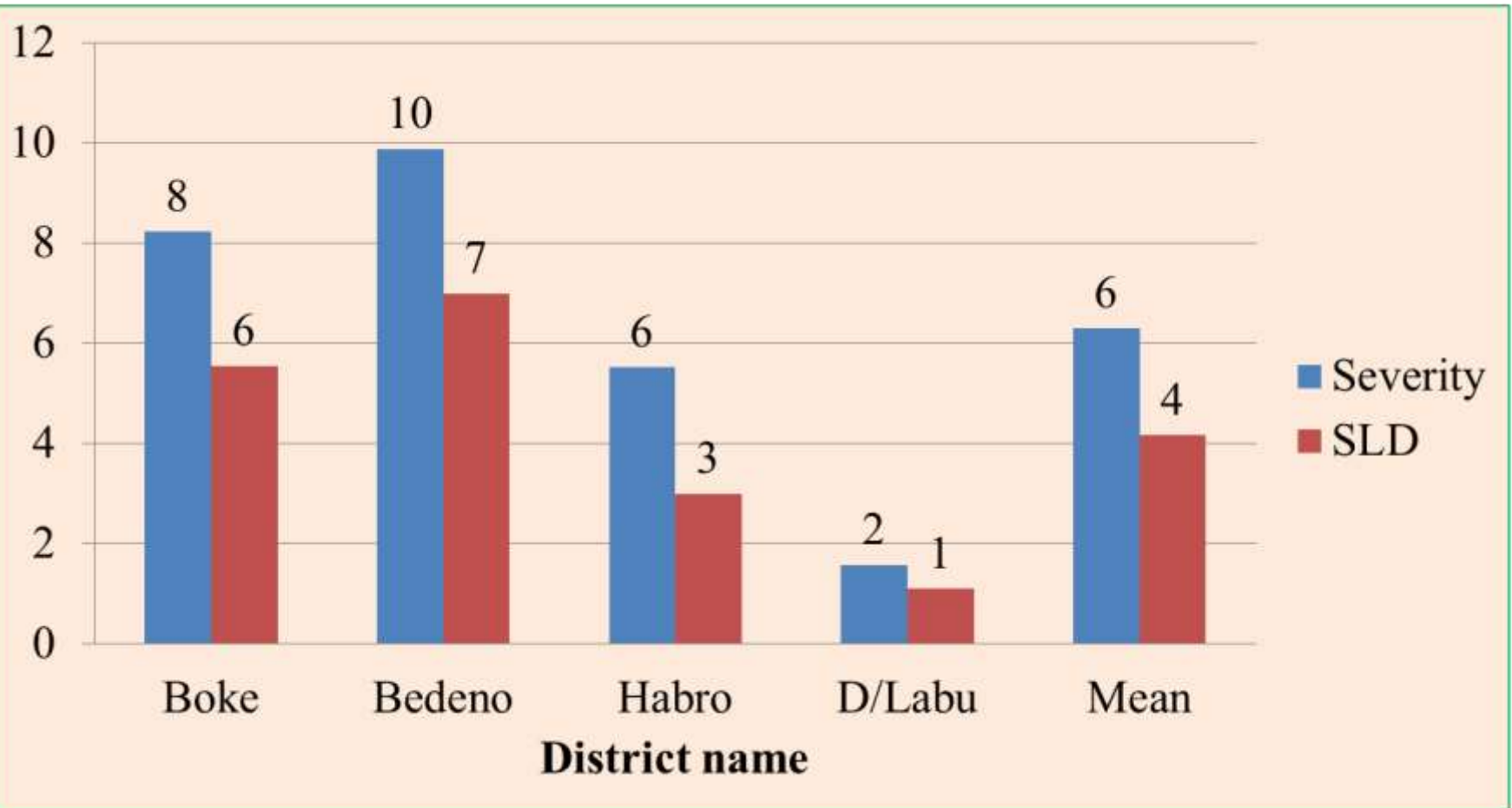


Figure 5. Severity and sporulation density (SLD) of CLR in different coffee growing districts environment



Farming practices *vs* Occurrence of disease

- Significant different infestation of disease were observed under shaded and un-shaded coffee farms (Table 3).
- Similarly agronomic management practice shows different effects on the severity and incidence of the disease (Table 4).
- Cultivation of coffee farm can reduces more disease occurrence than all other management practices (Table 4).
- This shows well managed plants are generally resistant and/or tolerant of diseases.

Table 3. Effect of coffee shade on the mean Incidence and severity of different coffee diseases

| Shade type | Incidence (%) | | | Severity (%) | | |
|------------|---------------|-------|-------|--------------|------|-------|
| | CBD | CLR | BDB | CBD | CLR | BDB |
| Un-shaded | 66.35 | 33.32 | 57.76 | 26.05 | 6.08 | 30.62 |
| Shaded | 64.14 | 31.57 | 21.00 | 35.07 | 6.85 | 10.12 |
| Mean | 65.71 | 32.81 | 47.04 | 28.68 | 6.31 | 24.64 |

Table 4. Effect of coffee field management practices on the disease infection

| Management practice | Incidence (%) | | | Severity (%) | | |
|---------------------|---------------|-------|-------|--------------|------|-------|
| | CBD | CLR | BDB | CBD | CLR | BDB |
| Slashing | 81.00 | 31.30 | 46.70 | 44.70 | 6.20 | 23.20 |
| Cultivation | 46.73 | 23.33 | 25.7 | 24.17 | 3.87 | 21.43 |
| Intercropping | 69.48 | 36.46 | 51.29 | 27.29 | 7.18 | 26.06 |
| Mean | 65.71 | 32.81 | 47.04 | 28.68 | 6.31 | 24.64 |

Conclusion and Recommendation

- Finding indicates that CBD, CLR, CWD & BDB were found as major diseases in the study areas.
- Their incidence and severity were varied among and within Hararghe areas based on the agro-ecological conditions and production system of coffee.
- All the areas are increasingly threatened by the diseases in which considerable coffee berry, leaf rust and bearing branches losses across all locations and agro ecology.
- However, CWD was reported in very low incidence across all coffee production of the study areas.

Conclusion and Recommendation ... Cont'd

- Generally, coffee production potential of Harerghe areas has been highly decreasing & changing to *khat* due to the above all mentioned results.
- Thus for producing sustainable, environmentally friendly organic coffee fetching premium price to farmers, the integrated management of diseases should be given due attention.
- Research should be strengthened in coffee disease protection by development of geographical specific disease resistant cultivars as long-term solution.

Conclusion and Recommendation ... Cont'd

- Farmers' indigenous knowledge need to be explored;
- All practices integrated with research work should be incorporated to develop integrated disease management method.
- As a last and short term option research should also be focused on appropriate chemical efficacy of disease control.
- This in turn could help to increase income generation to the coffee producers in specific and to the country in general; thereby increase foreign currency earnings.



THANK YOU



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