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Reaction of Gidame Coffee Collections to Major Diseases

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Ethiopia's largest export commodity is *coffee arabica*, one of the most significant goods that significantly contribute to the national economy. However, diseases including coffee berry wilt, coffee leaf rust, and coffee wilt significantly reduce its yield. In order to assess Gidame arabica accessions' resistance to serious fungal infections, this study was started. Eight standard checks on 92 accessions were removed in field and greenhouse conditions. With a range of 0–51%, 4–36%, and 0–100% disease severity, respectively, the results showed a highly significant variation (p 0.001) among genotypes for coffee berry, coffee leaf rust, and coffee wilt diseases. Most of the accessions had sensitive reactions to CBD under Gera conditions, with the exception of the four G67/13, G71/13, G54/13, and G66/13. As well, more than 40 coffee accessions revealed a 10% CLR reactivity, but none of the accessions had resistance levels higher than the two checks (Challa and 8136) at either location. Additionally, Gera had much greater levels of CBD and CLR than Haru. In other words, only two accessions, G57 and G20, showed 100% CWD survival in greenhouse environments. This study showed how plant genetics and environmental variables affect the development of disease and demonstrated that Gidame coffee accessions responded differently to

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the major coffee diseases assessed in various geographical regions. Therefore, continual massive genotype screening across several locations in unfavorable conditions for disease development must be taken into account in every host-pathogen relationship in order to get resistance genotypes as the best disease treatment choice.

Keywords: Coffea arabica; coffee berry disease; local landrace; resistance.

1. INTRODUCTION

Arabica coffee is one of the most important agricultural commodities, used as a key source of hard currency and a means of livelihood for various communities. Especially in Ethiopia, it is used for economic, social, and spiritual purposes with diverse cultural and/or psychological backgrounds for many communities [1,2]. Coffee is the world's second-most traded commodity next to petroleum and serves as a direct source of income for growers in different parts of the world [3,4]. In actuality, coffee is the spine of the Ethiopian economy, contributing more than 32% and 25% of foreign currency earnings and employment opportunities, respectively [5,6].

More than 10 million hectares of land have recently been used to cultivate coffee in more than 80 different nations [7]. Ethiopia is the main Arabica coffee origin and diversity region, ranking first and fifth by output volume in Africa and the globe, respectively [6]. *C. arabica* is the top agricultural producer in the nation due to the optimal conditions for agro-ecological variety within the forest, semi-forest, garden, and plantation production systems [8]. It is mostly grown in Ethiopia's Southern, South Western, Western, and Eastern regions [9] and covering 851, 42 ha of total area and yielding 570,198 tons per year (CSA 2020).

The southwestern part of Ethiopia is the homeland of *C. arabica, as* evidenced by the existence of wild coffee trees with 531,703 ha (69.5%) of total land coverage and 378,693 tons of production per annum [10]. From this, Kellem Wollega has covered about 90,626 ha of coffee land with 67,074 tons of production [11], which provides a great contribution to the national export market [12]. Due to the presence of the highest heterogeneous germplasm, Gidame district has been given a priority for local landrace development programs to encourage coffee production in the area. According to Zenebe et al.'s [11] report, coffee germplasm with the highest large area coverage existed at Gidame district in the zone.

Despite the fact that there are a lot of opportunities in this region, a number of diseases, such as coffee berry (*Colletotrichum kahawae*), coffee wilt (*Gibberella xylarioides*), and coffee leaf rust (*Hemileia vastatrix*), have a negative impact on coffee production [11]. In truth, diseases pose the biggest obstacles to the production of coffee in Ethiopia's tropical and subtropical regions [13].

Kahawae (Waller and Bridge 1993) is a big concern in Africa because it severely damages green coffee berries [14,15]. It is the main obstacle to the production of coffee, especially in Ethiopia [16,17]. In favorable settings where no control measures are adopted, the damage caused by CBD can result in up to a 100% yield loss [18]. Jirata and Asefa [19] also noted 22% and 80%, respectively, of the severity and occurrence of CBD. Likewise, Alemu et al. [15] similarly noted a national average incidence and severity of CBD of 52.5% and 29.9%, respectively. CLR disease is another productivity issue for the regions in addition to CBD. According to Cabral et al. (2015), the world's production of coffee has experienced a yield loss from CLR of over 75%. Similar to this, CLR disease, which has recently been estimated to have reached up to 47% of the country's disease severity, poses a risk to Ethiopia's coffee supply (Kifle et al., 2020). According to Arega (2006), coffee wilt disease poses one of the biggest obstacles to the country's coffee production and can be as severe as 30% of the time.

In fact, searching for important management options to alleviate today's serious coffee production challenges is crucial. So, for sustainable disease management in an environmentally compatible manner, using resistant varieties is among the first alternatives. In this regard, the coffee improvement program aimed to develop adaptive and disease-resistant varieties for various Ethiopian coffee ecologies. Obviously, the epidemics, occurrence, distribution, and economic impact of coffee

diseases vary across various agroecologies [20]. To overcome problems prevailing due to diseases, an agro-ecological-based local landrace screening study through the utilization of the genetic resources available in different coffee-growing areas is a vital and decisive option [9]. Therefore, this study was initiated to give deep insight on the potential of Gidame coffee accessions with the objective of evaluating the reaction of Gidame *C. arabica* collections to major diseases.

2. MATERIALS AND METHODS

2.1 Description of the Study Areas

The Jimma Agricultural Research Centre (JARC) is situated in Oromia Regional State in the Jimma Zone of Southwest Ethiopia. It is situated at an elevation of 1753 meters above sea level in a latitude and longitude of 07°46'0'"N and 36°47'0''E, respectively. It is located 12 kilometers west of Jimma town and 358 kilometers from Addis Ababa. It represents the medium agroecological zones, which experience 1572mm of yearly precipitation. The average temperature ranges are 11.60 °C and 26.30 °C, respectively. Chromic nitosols, cambisols, and fluvisols are the dominant soil types in the center (JARC, 2020).

Gera Agricultural Research Sub center (GARSc) has an average elevation of 1900 meters above sea level and is situated in Jimma Zone, South Western Ethiopia (latitude: 7°53'0''N; longitude: 36°38'0''E). With an average annual rainfall of 1877.8 mm, the region represents cool, subhumid, low- to high-altitude coffee-growing agro-ecologies. According to Netsere and Kufa [21], the region's minimum and maximum temperatures are 10.4°C and 24ºC, respectively.

The Haru Agricultural Research Sub-Centre (HARSc) is also situated between 8°54'30'' North latitude and 35°52'0'' East longitude, with an elevation of 1750 m.a.s.l. With an average annual rainfall of 1700 mm, the region exhibits a uni-modal rainfall pattern. Beginning in March or May and lasting until October is the rainy season. The average air temperatures for both the maximum and minimum are 27.8°C and 12.4°C, respectively. Acrisols and sandy clay loam are the soil types of the center [22].

2.2 Treatments and Design Used

For this study, 92 coffee accessions were collected from the Kellem Wollega zone of the country (Gidame areas), and eight standard checks were used. Field evaluation was undertaken at the Gera and Haru Agricultural Research Sub-centers, while laboratory and greenhouse studies were also undertaken at the Jimma Agricultural Research Center (JARC). The treatments for the field were laid out in a simple lattice design with 2m x 2m spacing and in a completely randomized design (CRD) for greenhouse studies.

2.3 Resistance Evaluation of Gidame Coffee Accessions for CBD

2.3.1 Field evaluation

Visual disease score: The overall disease pressure was evaluated on each accession using a 0–100% disease score visually for three consecutive cropping years in order to identify susceptible accessions early.

2.3.2 Evaluation for CLR

Each coffee accession underwent a visual assessment using a 0–100% scoring system to determine the extent of coffee leaf rust under field conditions.

2.3.3 Evaluation of CWD under greenhouse conditions

Coffee seedlings rising: Picked from mother trees, ripe cherries from 92 Gidame coffee accessions and two checks (370 and 279) were then painstakingly removed by hand from the skin and pulp and allowed to dry in the shade. The seedlings were sown in a plastic box after being vaccinated. After removing the parchment, the seed lots of each germplasm were first steeped in distilled, sterile water for roughly 48 hours. Each accession of soaking seeds (40 seeds per pot) was planted in heat-sterilized, wet sandy soil in clean plastic pots. To ensure sufficient moisture for seed germination, emergence, and plant growth during the experimental period, sterile water was routinely applied every two days. Sterile water was regularly applied every two days to maintain adequate moisture for seed germination, emergence, and growth of the plants throughout the experimental period.

2.4 The Pathogen (*Gibberella xylarioides)* Isolation

Specimens of partially wilting stems and diseased coffee trees were isolated using the

techniques detailed in Adugna [23] and the suggested media (PSA and/or SNA). A small portion (0.5 cm × 0.5 cm) of the specimen's white, healthy wood was cut from the specimen's intervening sections using a sterile scalpel after the bark had been carefully removed. Four to six tiny portions were placed in plastic petridishes, and 5 ml of 10% sodium hypochlorite was added. The mixture was uniformly stirred for 1 minute, and then the containers were promptly cleaned three times with sterile water. Four slices were aseptically plated using sterile forceps onto Petridishes (9mm) with potato sucrose agar after surface cleaning and blotting. The cultures were grown under 12-hour cycles of fluorescent light and darkness at a temperature of 22–20°C. The purified fungal colony that emerged from the plated sections was cultured on SNA. In order to be used for the subsequent inoculation, the *G. xylarioides* pathogen was purified, put into a suspension, and/or kept on sterile sandy soil.

2.5 Inoculum Preparation and Inoculation

Gibberella xylarioides was grown on SNA for two weeks at the same time on fresh branches or twigs. The twigs were collected from healthy trees and cut into small pieces (15 cm long), and the bark was slightly scratched off to expose the wood. The branches were placed in a test tube with a small amount of well-moistened cotton wool underneath and then sterilized in an autoclave. Each twig was inoculated with 2–3 ml of conidia suspension for 10 days under standard conditions [23]. The conidia used for inoculation were obtained by thoroughly rinsing the branches with good colony growth with sterile water in a sterile beaker, stirring them up with a magnetic stirrer, and filtering through double-layer cloth. The suspension was adjusted to the desired concentration of 2.3 x 10^6 conidia per ml.

Twenty seedlings per box (20/box) were infected by stem nicking techniques with a viable conidial suspension of the CWD pathogen (*G. xylarioides*) at the fully expanded cotyledon stage (8–10 weeks old) [24]. Each seedling's stem was notched at a depth of about 2 cm below soil level using a sterile scalpel dipped in the suspension, and a drop of the solution was then applied to the notch. The plants that had been treated were kept in a climate-controlled growth room with high relative humidity (>95%) and an infection temperature range (23-25ºC). The inoculated seedlings were moved to a greenhouse (with a temperature range of 15 to 30 °C and a relative humidity range of 60 to 80%) after 10 days. The experiment was laid out in a completely randomized design with three replications.

2.6 Data Collection

For six months, every two weeks, the number of withering seedlings that displayed external symptoms was counted. Periodically observed were the types of induced wilting and the incubation period (first symptoms to occur). The cumulative number of wilted seedlings over the total number of infected seedlings was used to calculate the percentage of wilted or dead seedlings.

2.7 Statistical Analysis

All collected data values were examined using the SAS statistical software application (SAS version 9.4) after data transformation (angular). ANOVA was utilized for variance analysis and the Duncan Multiple Range Test (DMRT) method for mean separation.

3. RESULTS AND DISCUSSION

3.1 Response of Coffee Accessions to Environments at Haru and Gera for CBD and CLR

The result showed a significant variation (p 0.05) among the accessions for CBD and CLR diseases (Table 1). The variation ranged from 0–51% and 1–97% for CBD disease infection under Haru and Gera conditions, respectively. Here, about 45% of the accessions showed a resistance reaction (with 0 to 4.60% disease severity), 24% of them also revealed a moderately resistant reaction (with 5–15% disease severity), and 31% of the accessions showed a susceptible reaction (>15% disease severity) for CBD under the Haru condition. Of which, CBD was not recorded (zero CBD infection) on G54, G55, and G56 accessions at this location (Haru). The four accessions G67/13, G71/13, G54/13, and G66/13 showed susceptible reactions to CBD under Gera better than the others (Table 1). Interestingly, these accessions also showed resistance reactions at both locations better than all the other accessions tested and relative to the standard checks.

Table 1. The response of Gidami *coffea arabica* accessions against CBD and CLR under field condition

Location											
Haru						Gera					
Genotype	CBD (%)	CLR (%)	Genotype	CBD (%)	CLR (%)	Genotype	CBD (%)	CLR (%)	Genotype	CBD (%)	CLR (%)
G-30/13	51.41	22.03	G-6/13	7.36	8.40	G-33/13	97.17	13.88	G-19/13	57.01	8.57
G-39/13	45.26	8.59	G-73/13	6.46	17.67	G-35/13	95.67	17.20	G-49/13	55.56	29.02
G-58/13	42.50	11.44	G-31/13	5.83	12.08	G-45/13	94.42	20.30	G-69/13	54.63	16.58
G-11/13	39.55	5.27	G-32/13	5.55	9.56	G-05/13	94.38	16.67	G-73/13	54.21	26.50
G-24/13	39.16	10.94	G-44/13	5.10	15.66	G-83/13	93.83	14.65	G-84/13	54.09	34.60
G-79/13	35.14	14.84	G-62/13	4.63	18.69	G-58/13	93.74	17.16	G-48/13	53.94	13.90
G-78/13	32.74	14.82	G-16/13	4.60	9.01	G-09/13	92.67	12.72	G-40/13	53.82	7.89
G-9/13	30.87	8.48	G-49/13	3.91	19.35	G-74/13	89.38	19.02	G-34/13	53.54	18.39
G-50/13	29.95	9.51	G-48/13	3.87	9.27	G-30/13	87.50	33.05	G-21/13	52.64	28.25
G-36/13	29.17	11.39	G-90/13	3.65	17.22	G-78/13	87.34	22.24	G-59/13	52.00	14.73
G-45/13	28.28	13.54	G-1/13	3.58	9.39	G-20/13	87.20	20.38	G-37/13	51.53	19.73
G-2/13	28.05	9.58	G-41/13	3.38	10.09	G-38/13	87.00	22.90	G-87/13	49.82	18.11
G-21/13	27.37	18.84	G-47/13	3.35	12.47	G-02/13	86.92	14.37	G-08/13	48.87	22.05
G-29/13	27.34	6.05	G-10/13	3.28	9.09	G-44/13	86.12	23.50	G-41/13	48.06	12.67
G-33/13	25.95	9.26	G-43/13	2.78	13.33	G-17/13	85.77	21.54	G-13/13	46.85	27.43
G-83/13	23.92	9.76	8136*	2.77	3.83	G-29/13	85.63	9.07	G-85/13	43.71	8.29
G-89/13	22.29	12.3	G-63/13	2.77	20.17	G-07/13	84.94	11.16	G-43/13	43.63	15.63
G-5/13	21.27	11.11	G-87/13	2.70	12.07	G-01/13	83.47	14.08	G-42/13	41.47	11.77
G-61/13	20.17	16.16	G-40/13	2.64	5.26	G-61/13	83.13	24.24	G-31/13	39.94	18.12
G-75/13	19.79	6.97	G-66/13	2.60	4.80	G-22/13	80.37	24.45	G-91/13	39.34	14.17
G-28/13	19.75	19.73	G-91/13	2.15	9.45	G-03/13	80.30	26.16	G-60/13	38.59	32.58
G-81/13	19.74	24.19	G-60/13	2.13	21.72	G-25/13	80.21	19.82	G-56/13	38.13	12.11
G-7/13	19.74	7.44	G-19/13	2.03	5.72	G-50/13	79.87	19.93	G-90/13	35.49	25.83
G-74/13	19.39	12.68	G-86/13	1.69	13.68	G-23/13	79.45	27.12	G92/13	35.33	25.87
G-12/13	19.03	12.73	G-80/13	1.66	16.44	G-24/13	78.34	16.41	G-51/13	34.96	19.75
G-46/13	18.77	17.79	Challa*	1.62	4.25	G-62/13	78.34	28.03	G-57/13	34.43	27.38
G-88/13	18.44	12.87	7576*	1.55	12.71	G-79/13	76.88	22.25	8136*	34.13	5.74
G-18/13	16.84	8.67	G-42/13	1.52	7.85	G-81/13	76.67	36.29	G-80/13	33.45	24.66
G-69/13	16.56	11.05	Haru-I*	1.38	8.15	G-89/13	75.43	18.45	G-63/13	30.20	30.26
G-22/13	16.13	16.3	G-37/13	1.31	13.89	G-39/13	75.11	12.89	G-10/13	29.09	13.63

Location											
Haru						Gera					
Genotype	**CBD (%)**	**CLR (%)**	**Genotype**	**CBD (%)**	**CLR (%)**	**Genotype**	**CBD (%)**	**CLR (%)**	**Genotype**	**CBD (%)**	**CLR (%)**
G-23/13	16.06	18.08	G-59/13	1.07	9.82	G-14/13	74.10	25.66	G-16/13	27.25	13.51
G-76/13	14.99	22.02	G-72/13	0.91	12.77	G-76/13	72.89	33.03	G-70/13	26.65	8.86
G-20/13	14.98	13.58	G-53/13	0.87	6.26	G-18/13	72.57	13.01	G-82/13	26.42	8.91
G-68/137	13.84	8.67	G-67/13	0.81	16.29	G-46/13	72.17	26.68	G-64/13	26.32	12.27
G-38/13	13.62	15.26	G-51/13	0.73	13.16	G-04/13	70.84	16.21	G-36/13	26.06	17.08
G-8/13	13.46	14.7	G-52/13	0.68	16.66	G-68/13	69.80	13.00	G-72/13	24.56	19.15
G-3/13	11.66	17.44	G-71/13	0.64	6.06	G-75/13	69.12	10.45	G-65/13	22.33	20.63
G-27/13	11.56	13.35	G-65/13	0.61	13.75	G-12/13	69.00	19.10	G-52/13	22.29	24.99
G-13/13	11.20	18.29	G-77/13	0.57	13.06	G-53/13	67.51	9.38	G-47/13	22.19	18.71
Sende	10.96	16.82	7514*	0.56	8.57	G-86/13	67.41	20.51	G-77/13	19.99	19.59
G-4/13	10.94	10.8	G-15/13	0.51	10.30	G-06/13	67.13	12.60	7514*	18.92	12.86
G-17/13	10.28	14.36	G-57/13	0.47	18.26	G-11/13	66.63	7.90	G-71/13	13.68	9.09
G-85/137	9.20	5.53	G-82/13	0.47	5.94	G-28/13	66.25	29.59	G-67/13	11.84	20.37
G-92/13	9.07	17.25	G-70/13	0.42	5.91	Sende*****	65.84	25.24	G-54/13	10.54	12.29
G-26/13	8.96	7.53	G-64/13	0.34	8.18	G-26/13	64.84	11.29	Haru-I*	10.06	12.23
G-84/13	8.78	23.07	7416*	0.00	5.69	G-32/13	64.79	14.34	Manesibu*	8.18	15.60
G-35/13	8.71	11.47	G-54/13	0.00	8.19	G-27/13	62.72	20.03	G-66/13	5.96	7.20
G-14/13	8.39	17.11	G-55/13	0.00	21.57	G-15/13	60.02	15.45	7416*	5.14	8.53
G-25/13	8.09	13.21	G-56/13	0.00	8.07	G-55/13	59.17	32.36	Chala	4.03	6.37
G-34/13	7.39	12.26	Manesibu*	0.00	10.40	G-88/13	58.86	19.31	7576*	1.08	19.07
			Mean	*11.45*	*12.30*				*Mean*	*56.02*	*18.46*
			LSD	*11.20*	*6.53*				*LSD*	*30.14*	*9.71*
			CV (%)	*59.45*	*26.88*				*CV (%)*	*27.06*	*21.97*

***NB**: Over year analysis was undertaken using the three consecutive years' data. The genotypes marked with "*" are the standard checks*

On the other hand, the CLR severity ranged from 4 to 23% and 6 to 36% at Haru and Gera conditions, respectively. The reactions to the accessions varied across the locations for this disease. Here, roughly 34%, 38%, and 22% of the accessions displayed CLR resistance levels of 15%, 10%, and >15%, respectively, under Haru conditions. While, under the Gera condition, 25%, 13%, and 62% of the tested accessions additionally displayed CLR infection severity of 15%, 10%, and >15%, respectively (Table 1). As the results showed, Gera had more severe CBD and CLR than Haru. This suggests that environmental factors have a significant influence on how well disease reactions may be attributed to genetic diversity among genotypes [25].

Host resistance (HR) is the most commonly used immune response, causing planned cell death in the area of the surrounding infection. This can establish a quarantine zone to stop the pathogen from spreading, an effective technique for pathogens that require living tissue. The epigenetic factors also serve as another layer of resistance response regulation by the plant. Besides, fungal pathogens can use enzymes like cellulases to degrade plant cell walls, and plants respond by producing enzyme inhibitors and depositing callose and lignin to strengthen the cell wall [26,27].

As research findings indicated, there are also different factors that influence disease epidemics. Kitage et al. [28] found that CBD epidemics depend upon the susceptibility of the host (C. arabica) varieties and the presence of the causative virulence disease (*Colletotrichum kahawae*) in the area. The formation of fungi-toxic compounds and cork barriers by resistance coffee genotypes reduce pathogen attack and blocks nutrient transfer. Zenebe et al. [29] reported that coffee genotypes can resist the pathogen attack by restricting conidial germination and the formation of appersoria. This can reduce pathogen infection sites and offer extra advantages for the genotypes in favor of movable resistance factors (Pinard *et al.* 2013).

In any pathosystem with different combinations, various infection strategies and host resistance mechanisms can exist [30]. So, plants response to the pathogen attack begins with the recognition of the pathogen itself. In coffee, CLR resistance can be governed by nine major dominant genes (SH1–SH9) that recognize the genes (V1–V9) of the virulence pathogen in combination with the virulence genes of the pathogen *H. vastatrix.* Hence, the production of rust-resistant *C. arabica* varieties can be achieved by generating its hybrids [31]. Diola et al. [32] reported that the source of resistance to *H. vastatrix* can be found in plants derived from the Hibrido de Timor, which is obtained from a continuous cross of *C. arabica* and *C. canephora.* Up-to-date, about 44 varieties have been released in Ethiopia, but most of them are susceptible to coffee leaf rust. This tells us that to mitigate the impact of *H. vastatrix* in the country, continuous, integral work in future breeding and pathological research is needed.

3.2 Evaluation for Coffee Wilt disease (CWD) under Greenhouse

Our findings showed that there was a significant difference (P 0.05) between the accessions with a wilt disease death rate ranging from 0 to 100%. A few accessions (G70, G58, G52, and G39) were shown to have a tolerant reaction to the disease with a range of 1.33–100% death rate. Out of 92 accessions, the majority of them showed a very susceptible reaction to coffee wilt disease (>50% death rate). It's interesting to note that the two accessions, G20 and G57, displayed resistance to the coffee wilt disease (Table 2). This may imply distinct genetic differences between the accessions. Therefore, in order to be suggested, these prospective resistant and tolerant accessions from this study must undergo further evaluation under sick plot conditions (CWD-infested or injected plot).

Due to genetic makeup, age of coffee genotypes, and environmental factors, there can be variations in coffee genotypes for CWD resistance [33]. According to Girma et al. [34], the occurrence of specific qualitative (vertical) reactions with quantitative (horizontal) resistance may be the cause of the variation in coffee cultivars vs. *Gibberella xylarioides* interactions in seedling tests. Similar to this, Van der Graaff and Pieters [35] and Girma [36] revealed that there were differences in the levels of CWD resistance between *C. arabica* genotypes [37,38].

Table 2. Reaction of Gidame coffee accessions for coffee wilt disease under greenhouse condition

Name of accessions	Infection %age (DR)	Name of accessions	Infection %age (DR)	Name of accessions	Infection %age (DR)
G-01/13	91.88	G-37/13	98.00	G-68/13	89.33
G-02/13	77.33	G-38/13	95.94	G-69/13	87.89
G-03/13	83.78	G-39/13	9.56	G-70/13	1.33
G-04/13	96.00	G-40/13	34.67	G-71/13	58.75
G-05/13	98.67	G-41/13	100.00	G-72/13	49.39
G-06/13	78.00	G-42/13	80.61	G-73/13	86.91
G-07/13	97.28	G-43/13	96.00	G-74/13	80.07
G-08/13	93.28	G-44/13	33.04	G-75/13	48.78
G-09/13	97.22	G-45/13	97.28	G-76/13	87.89
G-10/13	77.94	G-46/13	84.78	G-77/13	71.25
G-13/13	86.12	G-47/13	26.24	G-78/13	63.94
G-14/13	90.43	G-48/13	98.67	G-79/13	93.17
G-15/13	18.89	G-49/13	85.33	G-80/13	57.04
G-17/13	28.42	G-50/13	86.39	G-81/13	80.83
G-18/13	70.20	G-51/13	91.83	G-82/137	95.25
G-19/13	55.50	G-52/13	8.00	G-84/13	36.44
G-20/13	0.00	G-53/13	100.00	G-85/13	77.97
G-21/13	88.76	G-54/13	89.28	G-86/13	88.85
G-22/13	89.65	G-55/13	90.99	G-87/13	97.33
G-23/13	48.67	G-56/13	33.33	G-88/13	98.00
G-24/13	82.56	G-57/13	0.00	G-89/13	46.84
G-25/13	86.00	G-58/13	1.59	G-90/13	59.13
G-26/13	57.92	G-59/13	37.45	G-91/13	91.71
G-27/13	91.34	G-60/13	41.47	G-92/13	42.11
G-28/13	70.91	G-61/13	90.15	G-93/13	98.55
G-29/13	93.10	G-62/13	100.00	G-94/13	100.00
G-30/13	94.61	G-63/13	94.45	G-95/13	68.09
G-31/13	90.55	G-64/13	90.20	G-97/13	84.93
G-32/13	98.67	G-65/13	80.00	G-98/13	93.22
G-33/13	100.00	G-67/13	72.37	G-99/13	90.67
G-34/13	98.67			370	30.19
G-35/13	81.33			279	5.44
G-36/13	53.33				
				Mean	72.20
				CV (%)	11.36
				LSD	13.20

4. SUMMARY AND CONCLUSION

Arabica coffee is a curtail agricultural product that makes significant economic contributions to nations as a source of revenue for farmers, foreign currency earnings (32%), employment opportunities in rural and urban areas (25%), and others. Despite the fact that a variety of problems, primarily fungal diseases of berries, leaf rust, wilt, thread blight, etc., have had an impact on the crop's output, The most effective solution for disease control among the many management approaches is resistance. About 92 accessions were tested over several years for coffee berry, coffee leaf rust, and coffee wilt diseases, with the goal of developing local landraces. The findings showed substantial differences among genotypes in the disease severity ranges of 0–51%, 4–36%, and 0–100%, respectively. As indicated in the result, in Gera compared to Haru, the CBD and coffee leaf rust diseases were more severe.

Four accessions from the examined genotypes (G67/13, G71/13/G54/13, and G66/13) showed greater resistance to CBD than the others at both test sites. In addition, the seedling test results for the majority of the accessions have demonstrated a susceptible response, with the exception of the two “G57 and G20" that do not

exhibit wilt signs. This study demonstrates how environmental factors can prevent host-pathogen contact. This indicates that there may not have been an infestation in a natural field because there was no conducive environment or inoculum supply to support the spread of the diseases.

Overall, the current climatic change is causing different fungal diseases and disease epidemics to rise in the country's coffee-producing regions. Consequently, it is critical that future research emphasize the ongoing search for suitable management strategies by employing resistant cultivars through germplasm screening across various agroecologies of the country such significant diseases resistant coffee varieties. Additionally, coffee breeders can use and improve these accessions that showed positive outcomes for all diseases in this study by enhancing and incorporating all other related traits.

SIGNIFICANT STATEMENT

The study has identified some promising resistant *Coffea arabica* genotypes that can be beneficial for further research works especially for coffee breeders and help the researchers to uncover the critical areas coffee berry and wilt diseases in which researchers were not able to explore. Thus, anew theory on host resistance may be arrived at.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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