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Research Article

Assessment on Major Constrains of Enset (*Ensete ventricosum*) Landrace Production and Management Methods in Gurage Zone, Central Ethiopia

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Abstract

Enset (*Ensete ventricosum Cheesman*) is important crops in South, South western and Central part of Ethiopia. The assessment was conducted in major enset growing areas of Gurage zone during the 2021 cropping season with the objective of assessing major constrain of enset production and management methods at Cheha and Enemor Enore Woredas. The research site was selected with Gurage zine Agricultural office based on their enset production and cultivation. In each woredas four kebeles and five farmers were selected randomly. Farmers are growing enset landrace as intensive farming methods. In average 5-10 types of enset landraces were planting in their farm land. For propagating from 3-4 years enset landraces were preferred and germinating 50-100 sucker per plant. In both locations disease and wild animal is the major constrain of enset production. At Enemor Enore Woredas both disease and wild animal 60% and disease 25% whereas at Cheha worda disease 47.5% and both disease and wild animal 30% are the major constrains of enset production. In both location bacterial wilt is the major factors affecting enset production. In Cheha woreda 47.6% of enset landraces are tolerant to bacterial wilt reaction while 38.1% is susceptible whereas in Enemore Ener woreda 26.67% enset landraces are tolerant bacterial wilt while 23.33% is susceptible. The higher bacterial wilt prevalence was recorded in Cheha (77%) whereas in Enemore Ener woreda (57%). Among wild animal Porcupine and pig is the major factors for enset production. Therefore, for sustainable enset production, constant pest surveillance, planting a tolerant plant, Burring and rouging of the infected enset landrace, application of manure, removal of infected debris, and awareness creation are recommended to the local farmer.

Keywords

Enset Landrace, Number of Sucker Per Plant, Enset Production Constrains, Management Methods

1. Introduction

Enset (Ensete ventricosum (Welw.) Cheesman) is a monocarpic, herbaceous plant belonging to the Musaceae family and the genus Ensete [1, 2]. Enset grown at altitudes ranging from 1200 to 3,100 m.a.s.l. while the wild enset is distributed at an elevation of 1,200 to 1,600 m.a.s.l in Ethiopia [3]. Around 25 species of Ensete land races are distributed in Asia and Africa [4]. In Ethiopian E. ventricosum is widely grown and is a traditional staple food crop for over 20 million people in the South

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and South West parts of the country. It is estimated that about 146 thousand hectares in Southern Nations, Nationalities and Peoples Regional State (SNNPRS) and 79 thousand hectares in Oromia are covered with Enset [5]. Enset is playing a central role in the economic, social, and cultural life of the diverse ethnic people and provides a staple food in the south and southwestern part of the country [6]. The plant is a multipurpose crop in which all parts are utilized for different purposes [3]. The major foods obtained from Enset are kocho: decorticated leaf sheath and grated corm fermented into starch, bulla: a concentrated starch flour from fluid obtained by squeezing leaf sheath, and amicho: boiled corm pieces from young enset plants [3, 7]. A fermented *kocho* yield of 26–54 kg per plant managed with different transplanting stages. *Kocho* and *bulla* products can be stored for months to over 2 years depending on the wealth and consumption of the household farmers [8]. The energy yield of enset is by far higher than those of several kinds of cereal and is also reported to be higher than potato, sweet potato, and banana [9]. Enset food products have been used as a staple and/or co-staple food for the people who inhabit the country's southern, southwestern, and western parts [3]. The Gurage people are typically dependent on Enset as their main staple food and cultivating enset as an intensive farming system.

The production and productivity of enset are threatened by different biotic and abiotic factors. The biotic factors include diseases, insect pests, and wild animals, while the abiotic factors include mainly climatic and nutritional factors. Currently, enset plant diversity and production have been endangered by devastated enset bacterial wilt disease (EBW) which is caused by *Xanthomonas campestris* PV. *musacearum* [10]. In some enset-growing areas, such situations have caused farmers to abandon their enset farming and replace it with annual crops. However, such replacement is not favored due to the fact that enset growing regions are densely populated, and the average land spared for it is very small [11], hence annual crops grown on such a small plot cannot fulfill the food demand of the household. The tradition of sharing planting materials in the enset farming communities is believed to have contributed a lot to the dissemination of the disease across growing areas in the country.

The economic impact of the disease is potentially disastrous because it destroys whole plants leading to complete yield loss. The disease spreads within and across fields by means of contaminated tools, infected plant materials, and infested soil [12]. Enset production declining from time to time due to the bacterial wilt directly affecting the livelihood of more than 20 million enset growing farmers in the country. The Gurage zone is one of the disease-prone areas in which more than 35% of enset farms are infected with the disease [13]. The farmers are always waiting for an immediate solution. The disease prevalence varies with location and agro-ecology. The management of bacterial wilt of enset is difficult and mainly depends on preventive and sanitation practices. The use of resistant clones has been one of the effective management options for the disease. However, resistant clones are not well identified as compared to the worth sources of enset clones in the Gurage zone. Therefore, the objective of this assessment is to identify the major constrain, and management methods of enset landrace production at cheha and Enemor Ener woreda.

2. Materials and Methods

2.1. Sampling Procedures

The assessment was conducted in major enset growing areas of the Gurage zone, southern Ethiopia. From the recommendation of in Gurage zone Agricultural office of two enset growing Enemor Ener and Cheha woredas purposively selected. In each woredas, four kebeles were selected randomly and five household farmers were interviewed and their farms have been assessed. The numbers of plants in each quadrant were counted and all other data have been taken. Individual interview of farmers has been carried out for each kebeles.

2.2. Disease Assessment

Data on disease assessment have been taken by direct observation from the field and by an interview with the enset grower. From direct observation data like the health of the plant, spacing, cropping system, stage of the plant, and others have been taken. Disease data have been recorded as:

Disease Prevalence: was calculated using the number of fields infected divided by the total number of fields assessed and expressed in percentage [13].

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

Disease incidence: was calculated using the number of infected plants and expressed as a percentage of the total number of plants assessed [13].

$$\text{Incidence} = \frac{\text{Number of infected plants}}{\text{Total number of plants}} \times 100\%$$

2.3. Data Analysis

Simple descriptive statistics method was used to summarize data obtained from field surveys.

3. Result and Discussion

3.1. Enset Farming System and Production Constraints

The result showed that enset is the major food crop in the Gurage area enhancing food security and food self-sufficiency. In Gurage, Enset is cultivating as an intensive farming method and every farmer is cultivating a number of enset landrace in their farm. The farmers cultivate 5 -10 dif-

ferent enset landrace in their farms. 55% of the farmers have growing from five to ten (5-10) enset landrace in their farm, and 30% of which have less than or equal to five different landrace.

Table 1. *Major types of enset landrace in both locatios, Growing for human food and animal food.*

Cheha Woreda		**Enemor Enor woreda**	
Types of Enset landrace	**Purpose of growing**	**Types of landrace**	**Purpose of growing**
1. Yeshirakinke	Food	1. Lemat	Food
2. Separa	Food	2. Gambo,	Food
3. Nechiwe	Food	3. Shertiye	Food
4. Oret	Food	4. Wonadye,	Food
5. Astara	Food and medicinal value and *amicho*	5. Dere	Food and medicinal and testy *amicho*
6. Yiregiye	Food	6. Agade	Food
7. Lemat	Food	7. Amarat	Food
8. Meshenkeye	Food	8. Separa	Food
9. Kinkiye	Food	9. Gezwet	Food
10. Kanchiwe	Food	10. Lemare	Food
11. Agade	Food	11. Amarad	Food
12. Gimbewe	Food	12. Nechewe	Food
13. Bishiye	Food	13. Awenade	Food
14. Bazerye	Food	14. Beresye	Food
15. Gezwet	Food	15. Guarye	Food and medicinal and testy *amicho*
16. Yekeswe,	Food	16. Kanchiwe	Food
17. Badedet,	Food	17. Shirafiriye	Food
18. Amaratye,	Food	18. Yegendiye	Food
19. Gureye	Food and medicinal	19. Astara	Food and medicinal and *amicho*
20. Kibinar	Food and medicinal value and testy *amicho*	20. Kibnar	Food and medicinal value and tesy *amicho*
21. Gezewet	Food	21. Abenad	Food
		22. Badendet	Food
		23. Zobir	Food
		24. Gumbura	Food
		25. Aberat	Food
		26. Bazerye	Food
		27. Gimbewe	Food
		28. Ferezye	Food
		29. Shertiye	Food
		30. Ankefiye	Food

These enset landrace are grown for different purposes including *kocho* quality, medicinal value, *amicho*, early maturing, high biomass, and in addition to human feed all enset land race important to animal feed (Table 1).

In addition to food enset landrace like Astara, Gureye and Kibinar and Dere are important for medicinal value and repairing of bone fractures and broken human bone and more preferable for amicho feeding part (Table 1). The number of enset harvested per year varies among the farmers. 40% of the farmer harvesting greater than 50 ensets landrace and 26.3% of the farmers are harvesting less than 30 enset per year for *Kocho* and *Bulla* production (Table 2). Number of harvesting enset varied this is maybe the size of family member, pseudostem circumference, pseudostem height, corm size and pant height are affecting yield trait of enset landrace.

In all surveyed areas, enset propagation is exclusively by cutting. Cutting is usually done from *Hiba stage* (3-4 years old enset landrace) and the number of suckers that emerged from a single cutting varies depending on the type of enset landrace pseudostem circumference, soil nutrient, and environmental condition. The suckers that have grown from a single cut may vary from a few to more than hundreds. The present investigation revealed that from the total surveyed farmers, 52.5% of the farmers reported that they can get 50-100 suckers from a single cut and 23.8% of them get greater than 100 suckers. Although enset is propagated almost by asexually (cutting), it is also the most diverse crop (Table 2). The result agrees with the research [14] that farmers propagate enset cultivars that is primarily vegetative, for the production of suckers.

Enset production is affected by different production constraints. The major constraints were diseases and wild animals which may happen together or alone. The disease-account 36.3%, while 45% for wild animals together, and only 5% responded that they have no problem with enset production (Table 2). Invertebrate pests Porcupine and Wild pigs are affecting (21.3%), porcupine (31.3%), and wild pig (3.8%) of enset farms. Warthog is a problem in some parts of Enemore Enor Woreda. Porcupine affects enset production by consuming corms of enset plant, while Wild pig and Warthog consume kocho and bulla (Table 2). The result is in line with the research [15, 16] the major enset production constrains is Porcupine (86.1%), corm rot (83.3%), and EBW (19.4%) in Gurage zone.

Table 2. *Major constrains of Enset production at Enemor Ener and Cheha Woredas.*

Variable	Categories	Enemore Enor		Cheha		Total	
		Frequency	Percent (%)	Frequency	Percent (%)	Frequency	Percent (%)
Enset Harvested per Year for annual food	Less than 30	9	22.5	12	30	21	26.3
	30-50	17	42.5	10	25	27	33.8
	Greater than 50	14	35	18	45	32	40
Number of enset landrace in their farm	Less than or equal to 5	11	27.5	13	32.5	24	30
	5-10	22	55	22	55	44	55
	Greater than 10	7	17.5	5	12.5	12	15
Number of Sucker from a single cut	Less than 50	5	12.5	14	35	19	23.8
	50-100	24	60	18	45	42	52.5
	Greater than 100	11	27.5	8	20	19	23.8
Major Problems/ Constraints	Disease	10	25	19	47.5	29	36.3
	Insect Pest	0	0	2	5	2	2.5
	Wild Animals	5	12.5	4	10	9	11.3
	Diseases and Wild animals	24	60	12	30	36	45
	No Problem	1	2.5	3	7.5	4	5
	NK	10	25	21	52.5	31	38.8
Wild Animal	Porcupine	12	30	13	32.5	25	31.3
	Wild Pig	2	5	1	2.5	3	3.8
	Porcupine and wild pig	12	30	5	12.5	17	21.3

Variable	Categories	Enemore Enor		Cheha		Total	
		Frequency	Percent (%)	Frequency	Percent (%)	Frequency	Percent (%)
	Others	4	10	0	0	4	5
	Total	40	100	40	100	80	100

3.2. Enset Bacterial Wilt Disease Prevalence

Based on our observation and interview with the growers, diseases are the major problems for enset production in the area. Bacterial wilt of enset caused by *Xanthomonas campestris* pv. *musacearum* and corm rot (*Erwinia* sp. or *Dickeya*) are the major destructive diseases. The two diseases are the major problem for more than 86% of enset farmers and EBW is a major problem for more than 78% of the farmers. At the survey time, EBW disease was noticed by 62.5% of the farmers. The disease can affect any stage of the plant, but the incidence may vary at different stages of the plant's growth. *Hiba* (Stage 3, second transplant) and maturing (Stage 4, third transplant) plants were the most susceptible stages to EBW disease with 50% of the respondents indicating their farm was more affected at these stages (Table 3). The reason for this may be there is a high frequency of cutting for animal feed preparation and agronomic practices at these stages, which could increase the spread of the disease. The result agrees with the research [17] reported that the pest attacks Enset plants at any age, with infestations being the most serious on 2 to 4-year-old plants.

Even though the disease is occurring throughout the year, the occurrence of the disease may vary in different seasons. Hence 58.8% of the farmers reported that the disease is more severe during the rainy season (summer), while 12.5% of the farmers indicated the disease is the same all the season. These may indicate that the pathogen requires high moisture (Table 3). After the plant is infected by the disease, the recovery of the plant is very rare. The result is in line with the research [18] also reported that the disease is more serious in the summer time than winter season in the study area. The result is in line with the research [19, 20] reported that the pathogen requires humid conditions for survival.

From the survey, we noticed that the disease can cause the total loss of enset land race from their farm. This may be happened if the farmer is not managing their farm and growing with intensively. More than 38% of farmers lose greater than 30 ensets per year, while 26.3% of them lose 11 - 30 ensets per year and 20% of the farmers do not lose any enset plant due to EBW disease (Table 3). The result is in line with the research [21, 14] report that 30–100 enset plants harvested annually for 5–6person household.

3.3. Enset Bacterial Wilt Prevalence and Incidence

The prevalence levels of enset bacterial wilt in the Gurage zone is very high. From the assessed fields, 67 % of the farmlands showed bacterial wilt. The prevalence was very high in Cheha Wereda than Enemor Ener (Table 3). In both woredas, the prevalence was more than 50 %, which needs critical attention from the perspective of plant disease management.

Table 3. *Bacterial wilt disease prevalence and severity in both location.*

Woreda	Prevalence (%)	Incidence (%)
Cheha	77	11.92
Enemor Ener	57	10.62
Average	67	11.27

The disease incidence in both Cheha and Enemor Ener woredas were 11.92% and 10.62 % respectively and the average was 11.27%, this data is directly proportional to the loss of yield, there is 11.27 % enset yield loss due to bacterial wilt alone (Table 4). Even though some farmers use matured bacterial wilted enset plants for food purposes most of them are discarded from such usage, hence the disease incidence is directly proportional to the amount of loss. The incidence varies from field to field, but in some fields, it reaches up to 75 %. The result agrees with the research [13] Bacterial wilt of enset is one of the major biotic constraints of enset production in major enset producing parts of Ethiopia and it is widely distributed in all enset producing areas. It can result in up to 100% yield loss when causing complete wilting. The research [15, 16] reported that the bacterial wilt prevalence was moderate in Gurage as compared to Silt which is 13.5% and 23.3% respectively. This is maybe environment and altitude constrained. Basically, bacterial growth is affected by environmental factors.

3.4. Management of Enset Bacterial Wilt Disease

The management of BWE disease is difficult and no single action was yet recommended. However, implementing one or more methods could reduce the yield loss due to the disease. Farmers employ different endogenous disease management strategies used in combination or single, which could be effective or non-effective and some are not scientifically justified and may need further investigation. Almost all farmers with no BWE disease on their farms use prevention strategies to prevent the appearance of the disease on their farms. Most farmers in the surveyed area (37.6%) use sanitation or uprooting of infected enset plants and some burn the residue or bury it (Table 4). This management methods are a good method for reducing the spread of the disease. Some farmers also leave the infected plant in the field and are allowed to dry on the farm. This method is risky because the pathogen survives in the soil and residue for long period. The result agrees with the research [22] reported that preserving the infected land race will increase the disease severity. The pathogen invades systematically all tissues of the infected plant. Some of the farmers are growing tolerant enset land race , crop rotation, rotation of planting holes, burning of residues in the planting holes, and others. Crop rotation is practiced if their enset farm is totally infected with EBW, and avoid all enset and plant with cereals or vegetables for at least two years until the pathogen is clean from their farm. Crop rotation has proven effective in reducing pathogen populations. The result is in line with the research [23] reported that bacterial diseases of plants, once established the pathogen is difficult to control. The research [24] reported cultural practices and sanitation control measures are the most principal control measures for BWE. The research [25] good sanitation, curative mechanisms, use of disease-free sucker for planting material, crop rotation, and use of resistant clones can serve as viable management options for bacterial wilt of enset. The research [26, 15] reported that the application of amoxicillin at the rate of (1%) reduces the growth of bacterial wilt in Gurage isolate.

Uprooting/removing infected plants, farmers use diverse strategies to destroy the plant. If the infected plant is nearly maturing and freshly infected, they use for human food consumption. But they complained that the *kocho* and *bulla* quality of the infected plant is very poor and has a bad odor. Others may feed for their animals, and if they feed for animal, the cow dunk is not applied for enset because they think that the cow dunk obtained after the feeding of the animal with infected enset may transmit the disease to a healthy plant, hence they apply it to *Chat*, coffee or other crops. However, the potential transmission probability of the pathogen by cow dunk is not investigated yet, but less likely. On the other hand, 16.3% of the farmers bury the residue in the soil, while 28.8% of them throw the residue around their farm may be at their *Chat* or coffee farm (Table 4). The result is in line with the research [27] control measures to prevent, reduce or eliminate the spread of Xcm in enset fields including the disinfection/ flaming of enset cutting tools after use on infected plants, preventing animals from browsing infected plants, fencing infected sites and the rigorous removal of infected plants including the corms.The research [28] reported that Xcm can survive in Kocho for more than 14 weeks.

Some farmers revealed that there are some tolerant enset clones to EBW. Relatively tolerant clones at Cheha woreda include Yeshirakinke, Separa, Ankefiye, Amarat, Lemat, Gunbewe, Yekeswe, Kinke, Badedet, and Gezwet. While. Separa, Terye, Yiregye, Agade, Gezwet, Kanchiwe, Nechiwe, and Yekeswe clones were relatively susceptible clones for bacterial wilt at Cheha wereda. At Enemor Ener woreda Lemat, Agade, Gimbewe, Gezwet, Yegendiye, Separa, Gumbura Badedet tolerant to bacterial wilt Astara, Kibnar, Nechwe, Agade, Kanchiwe, Amarat and Separa were susceptible clones at Enemor Ener wereda. However, a tolerant clone for one farmer it may be susceptible for the other (Table 5). The result agreed with the report of [29, 30] reported that variable levels of clonal response against the *Xcm* disease have been observed under farmer's field conditions and while using artificial inoculation in on-station trials. The research [2] enset clones vary in their reaction to enset bacterial wilt. The research [31] an EBW disease sanitary management measure that helps to prevent reduce or eliminate the spread of *Xcm* disease. The research [13, 16] reported disease reaction was varying from enset landrace.

Phenotypically in Cheha woreda a total of 21 types of enset landrace was identified in farmers' fields among 47.6% enset landrace identified as tolerant, 38.1% is susceptible to bacterial wilt other 14.3% of enset landrace was not identified for its reaction. In Enemore Ener woreda 30 different types of enset landrace were identified. Among the total assessment, 26.67% are tolerant, 23.33% are susceptible to bacterial wilt while the other 50% enset landraces were not known for bacterial wilt reaction. Most farmers indicted that all enset clones are attacked by the disease, but the disease development rate and tolerance may vary. The result is in line with the research [32, 33] reported that there are over 200 enset vernacular names in Ethiopia. The research [34] particular clones may have different names in different geographic or language areas, while different clones could have the same name. The research [35] also mentioned that differences in names could be related to differences in the utilization of a clone and the change in vernacular name after an enset germplasm exchange between communities.

Table 4. *Enset Bacterial wilt disease assessment at Enemor Ener and Cheha Wereda.*

Variable	Categories	Enemore Enor (%)		Cheha (%)		Total	
		Frequency	Percent (%)	Frequency	Percent (%)	Frequency	Percent (%)
Disease Type	No Disease	4	10	6	15	10	12.5
	EBW	11	27.5	17	42.5	28	35.0
	Corm Rot	5	12.5	1	2.5	6	7.5
	EBW and Corm Rot	19	47.5	16	40	35	43.8
	Others	1	2.5	0	0	1	1.3
EBW occurring now?	Yes	24	60	26	65	50	62.5
	No	16	40	14	35	30	37.5
Number of Enset wilted per year	None	9	22.5	7	17.5	16	20
	Less than 10	6	15	6	15	12	15
	11-30	9	22.5	12	30	21	26.3
	Greater than 30	16	40	15	37.5	31	38.8
	Not Known	8	20	7	17.5	15	18.8
Susceptible Stages of enset to EBW	Hiba (Stage 3)	7	17.5	5	1.5	12	15
	Mesre (Stage 2)	0	0	0	0	0	0
	Fonfo (stage 1)	0	0	0	0	0	0
	Maturing (Stage 4)	4	10	8	20	12	15
	All	17	42.5	8	20	16	20
	Hiba and Maturing	4	10	12	30	25	31.3
Common Management Practices	Prevention	8	20	7	17.5	15	18.8
	Sanitation	5	12.5	8	20	13	16.3
	On farm drying	2	5	5	12.5	7	8.8
	Burning residue	3	7.5	3	7.5	6	7.5
	Care for instrument	2	5	1	2.5	3	3.8
	Sanitation and Burning residue	9	22.5	8	20	17	21.3
	Burning residue and Care for instrument	10	25	8	20	18	22.5
	Others	1	2.5	0	0	1	1.3
	Not Known	9	22.5	7	17.5	16	20
How to Destroy	Bury on farm	2	5	11	27.5	13	16.3
	Animal Feeding	2	5	0	0	2	2.5
	Human food	5	12.5	3	7.5	8	10
	Throw it around	5	12.5	7	17.5	12	15
	Animal feed and Human food	5	12.5	3	7.5	8	10
	Animal feed and throw it around	4	10	7	17.5	11	13.8
	Other	8	20	2	5	10	12.5

Variable	Categories	Enemore Enor (%)		Cheha (%)		Total	
		Frequency	Percent (%)	Frequency	Percent (%)	Frequency	Percent (%)
Severe Season	Not known	8	20	8	20	16	20
	Summer	20	50	27	67.5	47	58.8
	Winter	4	10	3	7.5	7	8.8
	All the same	8	20	2	5	10	12.5
Total		40	100	40	100	80	100

Table 5. *Response of enset landrace for bacterial wilt disease reaction.*

Cheha Woreda		Enemor Enor woreda	
Types of Enset landrace	**Disease reaction**	**Types of landrace**	**Disease reaction**
1.Yeshirakinke	Tolerant	1 Lemat	Tolerant
2 Separa	Tolerant	2 Gambo,	Susceptible
3 Nechiwe	Susceptible	3 Shertiye	Susceptible
4 Oret	Susceptible	4 Wonadye	Susceptible
5 Astara	Susceptible	5 Dere	Susceptible
6 Yiregiye	Susceptible	6 Agade	Tolerant
7 Lemat	Tolerant	7 Amarat	Susceptible
8 Meshenkeye	Susceptible	8 Separa	Tolerant
9 Kinkye	Tolerant	9 Gezwet	Tolerant
10 Kanchiwe	Susceptible	10 Lemare	Susceptible
11 Agade	Susceptible	11 Amarad	Susceptible
12 Gimbewe	Tolerant	12 Nechewe	Susceptible
13 Bishiye	Susceptible	13 Awenade	Susceptible
14 Bazerye	Susceptible	14 Beresye	Susceptible
15 Gezwet	Tolerant	15 Guarye	Susceptible
16 Yekeswe,	Tolerant	16 Kanchiwe	Susceptible
17 Badedet,	Tolerant	17 Shirafiriye	Susceptible
18 Amaratye,	Tolerant	18 Yegendiye	Tolerant
19 Gureye	Susceptible	19 Astara	Susceptible
20 Kibinar	Susceptible	20 Kibnar,	Susceptible
21 Gezewet	Susceptible	21 Abenad	Susceptible
22Ankefiye	Tolerant	22 Badendet	Tolerant
		23 Zobir	Susceptible
		24 Gumbura	Tolerant
		25 Aberat	Susceptible
		26 Bazerye	Susceptible

Cheha Woreda		Enemor Enor woreda	
Types of Enset landrace	**Disease reaction**	**Types of landrace**	**Disease reaction**
		27 Gimbewe	Tolerant
		28 Ferezye	Susceptible
		29 Shertiye	Susceptible
		30 Ankefiye	Susceptible

4. Conclusion and Recommendation

In the Gurage area Enset landrace cultivating is an intensive farming method and every farmer has cultivated five to ten phenotypically different enset landrace in their farmland. For one year of food security majority of farmers are harvesting 30- 50 enset landrace. This is dependent based on their family size, pseudostem circumference, pseudostem height, corm size, and corm height. After a process of fermentation kocho and Bulla production. Koch is eaten as a bread and Enjera form whereas bulla is eaten as a fluid form to maintain our body.

In Gurage, phenotypically different types of enset landrace are cultivated in farmer's fields. In assessing woreda both in cheha and Enemor Ener recorded different enset landrace types. Phenotypically in Cheha totally 21 types of enset landrace assessment among 47.6% enset landrace identified as a tolerant, 38.1% is susceptible to bacterial wilt other 14.3% of enset landrace was not identified for its reaction. In Enemore Ener woreda 30 different types of enset landrace were identified. Among the total assessment, 26.67% are tolerant, 23.33% are susceptible to bacterial wilt while the other 50% enset landraces were not known for bacterial wilt reaction. Most farmers indicted that all enset clones are attacked by the disease, but the disease development rate and tolerance may vary.

The production of enset is affected by different pests. Among the pests, bacterial wilt and vertebrate pests are the most important pest in assessing the area. From the assessment, BWE disease was noticed by 62.5% of the farmers. The disease can affect any stage of the plant, but the incidence may vary at different stages of the plant's growth. *Hiba* (Stage 3, second transplant) and maturing plants were the most susceptible stages to EBW disease with 50% of the respondents indicating their farm was more affected at these stages. The reason for this could be there is a high frequency of cutting for animal feed preparation and agronomic practices at these stages, which could increase the spread of the disease. The prevalence and incidence of bacterial wilt in cheha woreda are 77 and 11.92 whereas Enemor Ener Woreda is 57 and 10.62 respectively. Managing the pest by application of removing the infected plant, crop rotation, burning, and planting tolerated plant is one of the comprehensive management practices in the assessing area and its surrounding. To improve the quality and quantity of enset landrace the researcher is recommending to the local farmer pest surveillance, planting a tolerant plant, Burning and removing of the infected enset landrace, applying manure, and removal of plant debris are recommended to the local farmer.

Abbreviations

EBW Enset Bacterial Wilt

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Conflicts of Interest

The author declares no conflicts of interest.

Appendix

Figure 1. *Enset propagation by cutting, The enset land race is cutting from 3-4 year young land race.*

Figure 2. *Enset possessing for food from matured enset land race, The land race is matured from 5-7 years.*

Figure 3. *EBW disease symptom from the farmer field. The disease is infecting at any stage of the crop.*

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