



## Intensity of downy mildew in different accession of pearl millet and its upshot on yield in Hamelmalo region of Eritrea

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### ABSTRACT

Screening trials investigation was used to determine the prevalence and intensity of pearl millet major disease in the major crop growing climatic zone (Hamelmao, Zoba-Anseba, Eritrea). Sixteen pearl millet local entries were evaluated under natural field conditions in 2017 Agricultural years at Hamelmalo for their reaction to foliar and panicle diseases. The field trials showed that downy mildew (*Sclerospora graminicola*) in pearl millet was prevalent in 14 varieties out of sixteen. Maximum disease intensity due to downy mildew were recorded in Gudmay (66.6%) and Jengeren (61%) compared to the other accessions. The lowest downy mildew incidence was noted on Hagaz (16.1%), Bariyay908 (19.7%), Zibedi (21.9%) and Shleti (26.1%). The improved variety Kona (check) was free from downy mildew incidence. Maximum yield recorded in Bariyay908 while minimum recorded in Jengeren 2.92 and 0.68 ton per hectare. While in kona yield t/ha 2.78. Among all selected accession overall mean disease intensity and yield at 5% LSD 36.40 and 1.99 t/ha respectively.

**Keywords:** downy mildew, disease intensity, yield, pearl millet

### INTRODUCTION

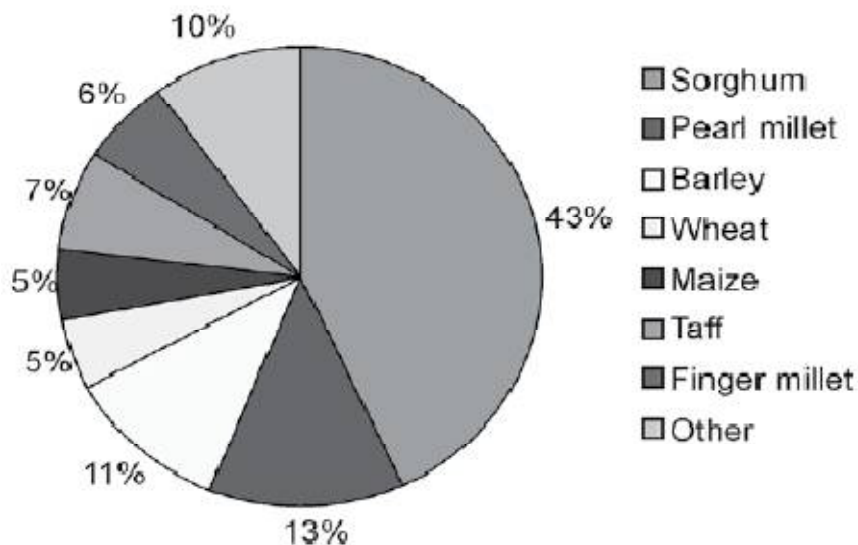
Eritrea is a country where 80% of the populations are subsistence farmers and pastoralists who derive their livelihoods in marginal and risk-prone environments characterized by recurrent drought and widespread land degradation. This sector of the population only contributes to approximately 20% of the country's gross domestic product (GDP). In good years, the country produces only 60% of its total food (cereals) requirements and in poor years it produces no more than 25%. About 95% of crop production depends on rainfall and 5% depends on supplementary irrigation using spate and river diversion to grow horticultural and field crops [8].

Pearl millet (*Pennisetum glaucum*) is grown for grain and forage in tropical and sub-tropical regions of Africa. In Eritrea, pearl millet is the second most important cereal in the country after sorghum and is grown by small-scale farmers on over 80,000 hectares, mainly in Anseba lowland and middle elevation regions. Out of total cultivated area in Zoba Anseba (60,000 ha), Pearl millet occupies 28080 ha with total average production of 23494.9 tons and average productivity of 960 kg ha<sup>-1</sup>. Moreover in Hamelmalo Sub Zoba out of the total cultivated area (9252 ha), pearl millet occupies 5210 hectare with total average production of 5595.8 tons and average productivity of 1070 kg ha<sup>-1</sup>. Therefore, pearl millet is the first important crop followed by sorghum in the Anseba region in terms of total area coverage [6,7].

Pearl millet is the second most important cereal crop in Eritrea, grown mainly by small farmers in low lands and mid lands. It is predominantly grown in less favorable environments where rainfall is variable and low (250-300 mm). Downy mildew is widely distributed in Eritrea. In the years 1999 and 2000, 30-50% of pearl millet plants were infected with downy mildew disease in most production areas surveyed in the Anseba and Gash Barka regions of Eritrea. This disease causes major yield reductions, estimated at 30% in Anseba in 2000. Farmers grow exclusively traditional landraces, which have many preferred traits and amodest grain yield potential, but are generally susceptible to downy mildew improved cultivars in 2000 i.e. Hagaz and kona is also affected by downy mildew in recent years. Downy mildew remains the most widespread disease of pearl millet, with continuing potential to cause catastrophic loss. Grain yield losses of 10 to 60% have been reported from various African and Asian countries [9, 10]. Downy mildew is widely distributed in Eritrea with 30-50% infection rate in pearl millet in Zoba Anseba and Gash Barka during the survey period of 1999 and 2000 [1]. This disease caused a major yield reduction which is

estimated to be a yield loss of 30% in Anseba alone in the year 2000. Downy mildew incidence in pearl millet was 12.95% in surveyed region of Anseba in 2012 [11].

#### Crop area coverage in Eritrea [9].



#### MATERIAL AND METHODS

The experiment of this study was conducted during 2017 kharif season in the field of the Agronomy, Hamelmalo Agricultural College, sub-zone of Hamelmalo, Eritrea. Hamelmalo has an average temperature of 36°C and an annual rainfall of 400 mm; however, its altitude is 1328 m above sea level. The trial was laid out considering 16 different accession for study of downy mildew of pearl millet incidence and effect on yield in 4 x 4 Simple Lattice Design in a Randomized block with 4 replication a gross plot size of 1.2 m x 3.0 m = 3.6 m<sup>2</sup>. The spacing between plants were 30 cm (4 hills/row = 1.2 m) with a spacing of 75 cm between rows (4 rows). The harvested net plot size was 1.80 m<sup>2</sup> with 2 rows (1.5 m) and 4 plants/row (1.2 m). During study, information was collected on the basis of different phenological stages of crops and aspect of major fungal disease of pearl millet i.e. downy mildew in Anseba region. In each plots, selected plants were assessed for fungal diseases of the panicle.

For survey, methodologies of James [3, 4] and Weeks *et al.* [12] were followed. Identities of the diseases were confirmed using standard references [2]. Downy mildew of pearl millet at the time of panicle emergence, green ear symptoms become visible. Symptoms appear on ear head with all possible degrees of proliferations and malformations. During malformation, the florets are converted into leafy structures of diverse appearance. Peculiar symptoms of downy mildew of pearl millet in the green ear stage are shown in Figure below.

The number of infected plants plot<sup>-1</sup> for downy mildew was counted and calculated as:

$$DM \text{ incidence} \% = n/N * 100$$

Where N is the total number of observed plants, n is the total number of diseased plants [5].

#### RESULT AND DISCUSSION

Production of pearl millet in Eritrea faces several major constraints. Abiotic limiting factors to production are drought, high temperatures, low soil fertility and poor cultural practices. Biotic constraints include diseases (downy mildew and anthracnose) and insect pests (stem borer, chaffer beetle, grasshoppers, locusts, caterpillars, ants and termites). Landraces currently grown contain the traits that farmers have selected over the past generations, and thus represent a very valuable resource. However, because of the cross-pollinated nature of the crop, desirable traits may not exist in a high frequency in landrace populations and maybe accompanied by various undesirable traits, such as susceptibility to downy mildew. Downy mildew incidence varied among the pearl millet accessions and the nature of the downy mildew attack in the pearl millet accessions is shown in Figure 1.

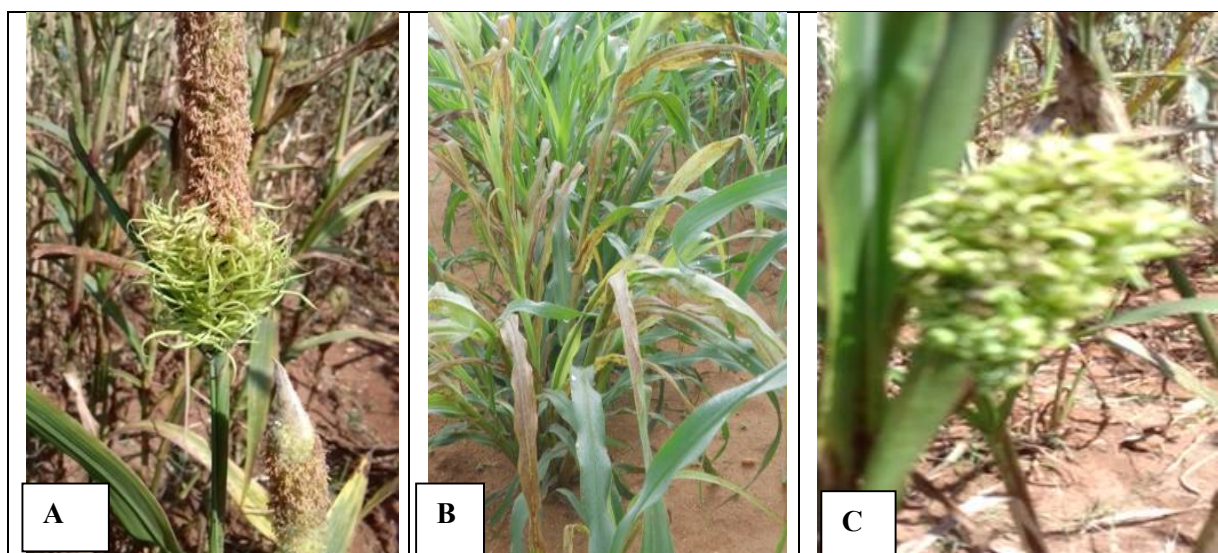


Figure1. Downy mildew disease in pearl millet accessions

Note: A and C= Downy mildew attack in the panicle and B = Downy mildew attack on leaves

In general, the infestation of downy mildew was higher in some of the accessions compared to improved varieties (check) Kona and Hagaz. The highest downy mildew incidence was noted in Gudmay (66.6%) and Jengeren (61%) compared to the other accessions. The lowest downy mildew incidence was noted on Hagaz (16.1%), Bariyay 908 (19.7%), Zibedi (21.9%) and Shleti (26.1%). The improved variety Kona (check) was free from downy mildew incidence. The yield t/ha recorded maximum in Bariyaya908 i.e 2.92 followed by Kona (2.78), Bariyay 910 (2.64), Zbedi & Hagaz (2.50) while Shleti, Delakda and Tokkiray yield t/ha 2.36. Minimum yield was recorded in Jegeren 0.28 t/ha and second maximum incidence were recorded in same accession at 5% LSD i.e. 61.00. The present study agrees with that of Mustapha [7] who indicated that there was significant difference in downy mildew among the pearl millet varieties and yield attribute and similarly with the finding of Downy mildew survey Research in Eritrea Bhasker *et al.* [1] who reported that widely distributed in Eritrea with 30-50% infection rate in pearl millet in Zoba Anseba and Gash Barka during the survey period.

**Table: 1: Downy mildew incidence and yield of pearl millet in sixteen accessions during 2017 Kharif season**

S.No	Accessions of pearlmillet	DM % incidence	Yield (t/ha)
1	<b>Kunama</b>	55.50	2.08
2	<b>Gudmay</b>	66.60	1.94
3	<b>Bartu</b>	37.80	1.53
4	<b>Bultug Nara</b>	46.30	1.25
5	<b>Mensura</b>	49.00	1.94
6	<b>Zibedi</b>	21.90	2.50
7	<b>Shleti</b>	26.10	2.36
8	<b>Jengeren</b>	61.00	0.28
9	<b>Bariyay908</b>	19.70	2.92
10	<b>Anseba</b>	35.80	1.11
11	<b>Bariyay910</b>	33.70	2.64
12	<b>Delakda</b>	34.60	2.36
13	<b>Tokriray</b>	30.70	2.36
14	<b>Ferdeghi</b>	48.00	1.25
15	<b>Kona</b>	0.00	2.78
16	<b>Hagaz</b>	16.10	2.50
<b>Mean</b>		36.40	1.99
<b>LSD (5%)</b>		19.15	0.97
<b>CV(%)</b>		36.90	34.20
<b>SE</b>		9.51	0.48

Note: LSD = least of significant, CV = coefficient variance, SE =standard error

**CONCLUSION**

The improved variety, Kona, showed a better tolerance in Downy mildew and Hagaz had relatively lower incidence of Downy mildew with 16.1% while most of the accessions had the highest incidence of Downy mildew like Gudmay with 66.6% and Jengeren with 61%. Hence, kona could be used as a source of Downy mildew resistance for breeding purposes. There are landraces identified with useful traits such as downy mildew resistance to be used for future crossing and breeding programs which is one of the bottlenecks in the production of pearl millet. However, more confirmation is required for downy mildew resistance by testing the landraces for additional season.

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**COMPETING INTERESTS**

Authors have declared that no competing interest exists.

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