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Finger Millet [*Eleusinecoracana* (L) Gaertn] Breeding in Ethiopia: A Review Article

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Abstract: *Finger millet is the most neglected and underutilized crop; however, it is the important food cereal crop for millions of poor farmers in Africa. This review paper was aimed to review the status and achievements of finger millet breeding in Ethiopia. Availability of genetic diversity and their characterization is vital for efficient and effective utilization in finger millet crop improvement. Therefore, maintaining and exploitation of finger millet germplasms is depends on understanding the genetic diversity of finger millet. The major finger production constraints are increasing incidence of diseases and insect pests, lodging, drought, lack of high yielding and stable varieties. Some efforts have been made for developing yielder, head blast tolerance/resistance finger millet varieties in the national sorghum and millet program, regional research institutes and higher learning institutes and were also released twenty four finger millet varieties for the last three decades. However, due to funding limitation for finger millet crop less attention has been given for finger millet crop research compared with other cereal crops and less number of finger varieties was released by different research institution of the country. Currently the national sorghum and millet research program and other research institutes are undertaking on developing finger millet varieties of different desirable traits for diverse agro-ecologies of Ethiopia.*

Keywords: *Finger millet, breeding*

1. INTRODUCTION

Finger millet (*Elucinecoracana*L. Gaertn), belongs to the *Poaceae* family, is one of the important food cereal crops in the Sub-Saharan Africa and South Asia region. It is the third most broadly produced millets after pearl millet (*Pennisetumglaucum*) and foxtail millet (*Setariaitalica*) in the semi-arid tropical and subtropical regions of the world (Asfaw*et al*., 2011). In Ethiopia, it is the sixth important cultivated cereal crops after tef, wheat, maize, sorghum and barley (Amare *et al*., 2019). It is frequently mixed with other cereal crops such as sorghum or tef to prepare composite flour for local food such as injera and porridge (Amare *et al*., 2019). It contains relatively higher concentration of calcium and dietary fiber than other cereal crops (Wondimu and Tekabe, 2001).

In spite of its importance, the current rate of yield increment in finger millet is inadequate in Ethiopia. Although a number of biotic and abiotic factors contributed to the lower grain yield increment, head blast is considered as one of the major biotic factors impeding finger millet productivity in Ethiopia. This limitation is reduced by developing finger millet genotypes which are more resistance or tolerance to head blast. Finger millet crop breeding is also an infant task as compared to other major cereal crops in the country.

The availability of wide genetic resources is a pre-requirement for any crop improvement. In spite of its wide resources, characterization of genetic resources is valuable for efficient and effective utilization in crop improvement programs. Success of breeding program depends to a large extent upon the choice of desirable parents of diverse genetic resources. In Ethiopia, Some finger millet improvements via characterization, crossing and adaptation have been done in national sorghum and millet program, regional research institutes and higher learning institutes.

Determining adaptable and stable high yielding genotypes with other desirable traits under diverse environmental conditions to recommend a new variety (ies) for release as variety is basic and this has direct bearing on the adoption of a variety, productivity and total production of the crop

(Showemimo*et al*., 2000; Mustapha *et al*., 2001). Therefore, the objective of this review was to review the status and achievements of finger millet breeding in Ethiopia.

1.1. Origin and Distribution of Finger Millet

The wild type species of finger millet was discovered in Axum, Ethiopia and is thought to date back to 3000 B.C. (Hailu*et al*., 1979). Cultivated type of finger millet, *E. coracana* subsp. *coracana*, is considered to have been domesticated some 5,000 years ago from the wild *E. coracana* subsp. *africana* (2n=4x=36) in the highland areas that distributes from Ethiopia to Uganda. *Elucinecoracana*subspecies *africana* is the spontaneous hybridization event between the diploid E. indica (AA genome) and an unknown B-genome donor (Neves *et al*., 2005). Domesticated finger millet was subsequently expanded to the lowlands areas of Africa and around 1000 B.C. introduced into India through the sea trade that existed between India and Africa (Hailu*et al*., 1976). India became a secondary centre of diversity for finger millet.

1.2. Finger Millet Genetic Diversity

The accessibility of wide genetic resources is a prerequisite for any crop improvement. Besides the availability of genetic resources, their characterization is vital for efficient and effective utilization in crop improvement programs. Success of any crop breeding program relies on to a large diversity of the genetic resources upon the selection of elite parents with various desirable traits (DINESH *et al*., 2010).Genetic diversity assessment helps in understanding intra-species crop performance that can be exploited in crop improvement (Aremu, 2011), and offers information on the extent of genetic divergence. It also aids as a platform for specific breeding objectives (Thompson et al. 1998) and identifies parental combinations exploitable to create segregating populations with maximum genetic potential for further selection (Dagnachew*et al*., 2017).Fruitful genetic maintenance and exploitation of any crop is largely relying on understanding the genetic diversity and its distribution in a given region (Varshney*et al*., 2007).

Even though, Ethiopia is the center of origin for finger millet, detail researches on finger millet diversity using morphological or molecular markers are generally inadequate (Dagnachew*et al*., 2017), few germplsams have been characterized at morphological level (Dagnachew*et al*., 2012a,b; Chemeda*et al*., 2008; Andualem*et al*., 2011; Kebere*et al*.; 2006)and few study has been done at the molecular level using molecular markers (Kebere, 2011) and (Dagnachew*et al*., 2014 a,b).

1.3. Importance of Finger Millet Production

Finger millet (Eleusinecoracana (L.)Gaertn.)Is one of the most important millet cultivated in eastern and southern Africa. Its Area coverage and production is 4.5 million hectares and 5 million tons, respectively, in the world. In Ethiopia, it is produced on 456,171.5 hectares, from which 10.3 tons are produced and its national productivity is 2.2 tons/ha (CSA, 2017). Finger millet is widely produced in the cool high altitude areas in the region mainly as source of food and traditional alcoholic beverages (ICRISAT and FAO, 1996).

In Ethiopia, the crop is mainly grown in the northern, north western and western parts of the country, especially during the main rainy season. It uses as a subsistence and food security crop that is especially important for its high nutritive and culture value (Andualem*et al*., 2013**)**. Finger millet being a promising source of micronutrients and protein (Malleshi and Klopfenstein, 1998) in addition to energy, can use a contribution to solve micronutrient and protein malnutrition, also called 'hidden-hunger', disturbing more than half of the world's population, especially women and children in most countries of Africa and south-east Asia (Underwood, 2000). It is an important food crop in traditional low input cereal-based farming systems in Africa, and is of particular significance in upland areas of Eastern Africa (National Research Council, 1996). It has high a nutritious crop with a fair amount of protein (7 – 14%) (Barbeau and Hilu, 1993) and is rich in calcium, iron, methionine, phosphorus, carbohydrate (Leung *et al*., 1968) and dietary fibre (15–20%) (Chethan and Malleshi, 2007). Similar to tef, its grain can be stored for many years under local storage conditions without significant damage by storage pests (Asfaw*et al*., 2011). In Ethiopia, traditionally it is used for making 'injera', bread, mixed with tef, porridge, local beer 'tella' and a powerful distilled spirit 'areke' and a number of other uses. Finger millet grain has good taste and is an excellent dietary source of methionine (an amino acid lacking in the diets of hundreds of millions of the poor who live on starchy foods like cassava, plantain, polished rice, and maize meal).

1.4. Constraints of Finger Millet Production

The national average finger millet productivity in Ethiopia is 2.2 tons/ha (CSA, 2017). Several production constraints were identified as limitation for finger millet production and productivity enhancement. The major constraints include lack of stable high yielding, adaptable and good quality improved varieties, increased incidence of diseases (mainly head blast) and insect pests (grass hoppers and shoot fly), lodging, drought, little research emphasis has given to the crop, poor adoption of improved technologies, poor attitude to the crop (Hailegebrial Kinfe *et al*., 2017). In general, breeding efforts in finger millet has been limited and farmers are growing unimproved and low yielding cultivars (Dagnachew*et al*., 2014). Due to finding limitation less research attention has been given to the crop as compared to other cereal crops.

1.4. Achievements of Finger Millet Breeding In Ethiopia

Formal research to improve finger millet crop started three decades ago. Research on finger millet was initiated at DebreZeit research station in the late 1950s. The national sorghum improvement program based at Melkassa re-initiated finger millet research in 1986.The major production constraints are head blast and leaf disease, drought, lodging (Hailegebrial Kinfe *et al*., 2017) and hence research emphasis has been given developing tolerant/resistant varieties via national sorghum and millet research program, regional research institute and higher learning Institutes. The resource of breeding materials is obtained from local source, ICRISAT, Ethiopian Institute of Biodiversity and effort has been made towards identifying the tolerant/resistant materials and there by introgression of tolerance/resistant traits in to adapted farmer preferred varieties through crossing and back crossing.

However, due to funding limitation for finger millet crop less attention has been given to finger millet crop as compared to other cereal crops less number of varieties were released in the last three decades (Asfaw*et al*., 2011). Over the past three decades 24 improved finger millet varieties with various desirable traits were released for the different agro ecologies of the country (MoANR, 2019).

Table1: *List of released finger millet varieties in Ethiopia*

Entry	Variety	Year of release	Maintainer	Character
1	Jabi	2019	ADARC	Tolerant to blast and Lodging
2	Diga-2	2018	BARC	Tolerant to major diseases (leaf, head blast)
3	Bako-09	-	BARC	-
4	Tekeze-1	2018	SARC	Moderatly resistance to major diseases
5	Mereb-1	2016	AXARC	Resistance to blast
6	Urji	2016	BARC	Resistance to blast
7	Diga-1	2016	BARC	Resistance to blast
8	Axum	2016	MARC	Resistance to blast
9	Meba	2016	MARC	Yielder and Resistance to blast
10	Addis-1	2015	AAU	Resistance to blast
11	Kako-1	2015	JARC	Blast and drought resistance
12	Mecha	2014	ADARC	blast/lodging resistance
13	Gudetu	2014	BARC	Head & leaf blast resistance
14	Tessema	2014	MARC	Yielder
15	Necho	2011	ADARC	Tolerant to major diseases of finger millet
16	Debatsi	2010	PARC	Tolerant to major diseases of finger millet
17	Bareda	2009	BARC	Tolerant to major diseases of finger millet
18	Gute	2009	BARC	Tolerant to major diseases of finger millet
19	Wama	2007	BARC	-
20	Baruda	2007	PARC	Resistant to grain mold
21	Degu	2005	ADARC	Moderately resistance to blast
22	Boneya	2002	BARC	Head blast
23	Tadesse	1998	MARC	-
24	Padet	1998	MARC	Moderately tolerant to blast

Where; BARC = Bako Agricultural Research Center, MARC = Melkassa Agricultural Research Center, PARC = Pawe Agricultural Research Center, ADARC = Adet Agricultural Research Center, AXARC = Axum Agricultural Research Center, JARC = Jinka Agricultural Research Center, AAU = Addis Abeba University.

2. CONCLUSION

Finger millet is one of the most neglected cereal crops worldwide; however, it is an important staple food crop for millions of poor farmers in East and Central Africa where it uses as a subsistence and food security crop. It contains relatively high concentration of calcium and dietary fiber than other cereals. The major constraints of finger millet in Ethiopia are lack of high yielding and stable varieties, increased incidence of diseases and insect pests, lodging, drought. Finger millet production limitations can be solved by developing high yielding with tolerance/resistance varieties via introgression of tolerance/resistance finger millet varieties. Wide genetic diversity is the basis for any crop breeding. In Ethiopia, few finger millet germplasms have been characterized at morphological and molecular level. Further characterization of finger millet germplasms is needed for different desirable traits. Due to funding limitation less research attention has been given to the crop as compared to other cereal crops and less number of finger millet varieties was released for the past three decades. In general, further work is needed to exploit the diverse genetic resources to create segregating populations with maximum genetic potential for further selection.

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