

Early generation seed Production in Areka Agricultural Research Center of Southern Agricultural Research Institute: Status, Challenges, and Opportunities

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Abstract

Seed is the most important agricultural input for improving production and productivity. The objective is to show the status, challenges, and opportunities of early-generation seed production in the Areka Agricultural Research Center (AARC) of the Southern Agricultural Research Institute in the cropping season (2016/17–2021/22). The main purpose of Early Generation Seed (EGS) production is to maintain the genetic potential and identity of a variety and provide a regular supply of high-quality breeder seed, which is the basis for subsequent seed production. Ethiopia has adopted four seed classes for seed production: breeder seed, pre-basic seed, basic seed, and certified seed. Using quality seeds of a variety with high genetic potential (as for the improved varieties) can increase yield. A total of 1253.21 and 511.16 quintals of major cereals and pulse EGS were produced in the 2016/17–2021/22 cropping season, respectively. From 2016/17–2021/22 cropping seasons, the Areka Agricultural Research Center produced a total of 27973 EGS of Enset corn and suckers. In the 2016/17–2021/22 cropping seasons, AARCs produced a total of 6015 quintals of EGS of the Boloso-1 variety. The main challenges and opportunities are to either decrease or enhance EGS production in the Center. This implies that AARC's capacity to produce early-generation seeds will improve in order to fulfill the existing demand for EGS.

Keywords: Challenges; Early Generation Seeds; Opportunities; Production; Status

Introduction

Seed vehicles for delivering the benefits of technology are the most important basic input, influencing the growth and sustainability of agriculture [1]. It is an enigmatic genetic capsule essential for the multiplication and establishment of species from one generation to another. Seed is the most important agricultural input for improving production and productivity, and it is the basic unit for the distribution and maintenance of plant populations [2]. Seed is also an important component of agricultural production and the availability of viable and vigorous seeds at the planting time is very important for achieving the yield target [3]. The use of quality seeds of a variety having high genetic potential (as for the improved varieties) can increase yield by 20–25% [4]. Quality seeds, according to other authors, can increase yield by 5–20% [5]. The quality of seeds is widely acknowledged to be an important factor in increasing agricultural productivity to enhance food security and reduce poverty in Africa [6].

Ethiopia adopted the Organization for Economic Cooperation and Development (OECD) nomenclature for seed production and certification with some minor variations: breeder seed, pre-basic seed, basic seed, and certified seed [7, 8]. Accordingly, the breeder seed is the seed of the first generation produced under the supervision of the plant breeder. Pre-basic seed is the progeny of breeder seed and is particularly used for crops with a low multiplication factor. Basic seed is the progeny of pre-basic seed and is usually provided to certified seed producers and suppliers. Certified seed is the progeny of basic seed and is produced for sale to farmers.

Early generation seed (EGS) production constitutes the maintenance breeding of improved varieties and regular multiplication and supply of high-quality breeder, pre-basic or basic seeds [9]. For large-scale certified seed producers. Among these, the availability and quality of early-generation seed (EGS) have been identified as one of the major constraints on the national seed sector [10]. Newly released crop

varieties need to be multiplied and made available to farmers as quickly as possible for farmers to access and benefit from the genetic gain of the crop improvement programs. Areka ARC is given the responsibility of producing EGS (breeder, pre-basic, and basic) of varieties that are released by the federal and regional agricultural research institutions. According to the seed production plan, different EGS classes were multiplied by the Areka ARC based on the capacity and agro-ecological suitability of the crops. EGS multiplication of breeder, pre-basic and basic seeds is coordinated by the source technology multiplication and seed research work process of Areka ARC even though it works in collaboration with crop breeding departments.

Early generation seeds are expected to meet a high standard of varietal purity and seed quality attributes prescribed by national seed regulations [11]. This includes field standards to maintain varietal purity and identity and seed standards in terms of physical, physiological, and health quality. Field inspection is used for the former, and laboratory seed testing is used for the latter. Applying the recommended technical procedures and agronomic management practices [12]. During variety maintenance and seed production would ensure production EGS of the highest varietal purity, identity, and seed quality.

All early generation seeds except breeder seeds are expected to be of the highest seed quality standards, and the subsequent generation of

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pre-basic and basic seeds needs to be inspected, tested, and approved by the seed certification agency [13-15]. The aim of this article is, therefore, to show the status, challenges, and opportunities of early-generation seed production in the Areka Agricultural Research Center of the Southern Agricultural Research Institute.

Results

Temperature and precipitation data

The mean temperature and precipitation of the EGS production site of Areka ARC

Early generation seed production of cereal crops

A total of 1253.21 quintals of cereal EGS were produced in the 2016/17-2021/22 cropping season (Tables 1 and 2). The highest share of 358 quintals of wheat seed was produced in 2016/17, followed by 283.91 quintals in 2017/18. Similar to that of wheat, the highest share of 87.54 quintals of tef seed was produced in 2021/22, followed by 42.5 quintals in 2020/21 (Tables 1 and 2).

Early generation seed production of wheat (*Triticum aestivum* L.)

In the Areka Agricultural Research Center, pre-basic and basic seeds of wheat were multiplied by the source technology multiplication and seed research work process in the 2016/17-2021/22 crop season (Table 1). About 1063.5 quintals of early generation seed of different seed classes were produced in the 2016/17–2021/22 crop seasons. The highest share of 87 quintals of seed was produced from the variety Ogolicho basic, followed by 79 quintals of the variety Shorima basic seed in 2016/17. The lowest share of 2.78 quintals of seed was produced from the variety Ogolicho basic in 2021/22 (Table 1). The amount of

wheat produced in the last six years showed a decremented trend. The major causes of the decrease in the amount of wheat seed production were insufficient budget allocation, unpredictable fluctuations in weather conditions, and diseases.

Early generation seed production of tef (*Eragrostis tef* (Zucc.) Trotter)

In total, 201.71 quintals of EGS of tef were produced from the 2016/17-2021/22 cropping season (Table 2). The highest share of 32.82 quintals of seed was produced from the variety Areka-1 pre-basic in 2018/19, followed by 21 quintals of the variety Cr-37 pre-basic seed in 2019/20. The lowest share of 1.2 quintals of seed was produced from the varieties Cr-37 pre-basic and Boset basic in 2017/18 (Table 2).

Early generation seed production of pulse crops

A total of 511.16 quintal EGS of major pulse crops were produced by Areka ARC from the 2016/17-2021/22 cropping season (Figures 1, 2, and 3). The highest share of common bean EGS is produced, followed by faba beans and chickpeas.

Early generation seed production of Common bean/Haricot bean (*Phaseolus vulgaris* L.)

About 336.8 quintals of EGS of common beans were produced from the 2016/17-2021/22 cropping season (Figure 1). The highest share of 150.75 quintals of seed was produced from the variety Nasir basic, followed by 58 quintals of the variety Hawassa Dume basic seed in 2016/17. The lowest share of 2 quintals of seed was produced from the variety Nasir basic in 2021/22 (Figure 1). Even if the amount of seed produced decreased for the last two years due to erratic rainfall, the extent of seed utilization increased consecutively.

Table 1: The amount of pre-basic and basic bread wheat seed produced by Areka ARC of Southern Agricultural Research Institute, 2016/17-2021/22.

Crop	Variety	Quantity of seed produced (qt.)					
		2016/2017	2017/2018	2018/2019	2019/2020	2020/2021	2021/2022
Wheat	Shorima pre-basic	0	42	71	8.75	16	21.07
	Shorima basic	79	55	0	0	0	0
	Ogolicho pre-basic	0	21	84.5	0	11.40	19.92
	Ogolicho basic	87	0	0	0	0	2.78
	Kingbird pre-basic	0	60.5	0	0	56.79	0
	Kingbird basic	25.5	0	0	0	0	17.85
	Wane pre-basic	0	0	0	0	50.70	0
	Wane basic	0	0	0	0	0	41.13
	Hiddase pre-basic	0	61.61	0	0	0	0
	Hiddase basic	60.5	7	0	0	0	0
	Kakaba pre-basic	0	0	8	0	0	0
	Kakaba basic	54	0	0	0	0	0
	Huluka	52	36.80	0	0	0	0
	Lemu	0	0	0	11.70	0	0
	Total		358	283.91	163.5	20.45	134.89

Table 2: The amount of pre-basic and basic Tef seed produced by Areka ARC of Southern Agricultural Research Institute, 2016/17 – 2021/22.

Crop	Variety	Quantity of seed produced (qt.)					
		2016/2017	2017/2018	2018/2019	2019/2020	2020/2021	2021/2022
Tef	Cr-37 pre-basic	0	1.2	3.45	21	16	6.73
	Cr-37 basic	0	0	0	0	21	40
	Boset pre-basic	0	0	0	0	0	7.55
	Boset basic	0	1.2	0	0	5.5	23.5
	Areka-1 pre-basic	0	0	32.82	0	0	0
	Areka-1 basic	0	0	0	0	0	9.76
Total		0	2.4	36.27	21	42.5	87.54

Early generation seed production of Faba bean (*Vicia faba* L.)

About 143.98 quintals of early generation seed of different seed classes were produced in the 2016/17-2021/22 crop season (Figure 2). The highest share of 29.80 quintals of seed was produced from the variety Dosha pre-basic, followed by variety Dosha pre-basic seed in 2019/20 and 2020/21, respectively. The lowest share of 3.75 quintals of seed was produced from the variety Degaga basic in 2017/18 (Figure 2).

Early generation seed production of Chickpea (*Cicer arietinum* L.)

About 30.38 quintals of early generation seed of different seed classes of chickpea were produced in the 2016/17-2021/22 crop season (Figure 3). The highest share of 9 quintals of seed was produced for the variety Natoli basic, followed by the variety Arerti pre-basic seed in 2016/17. The lowest share was produced by the variety Natoli basic in 2017/18 (Figure 3). From 2018/19-2020/21 the three consecutive years

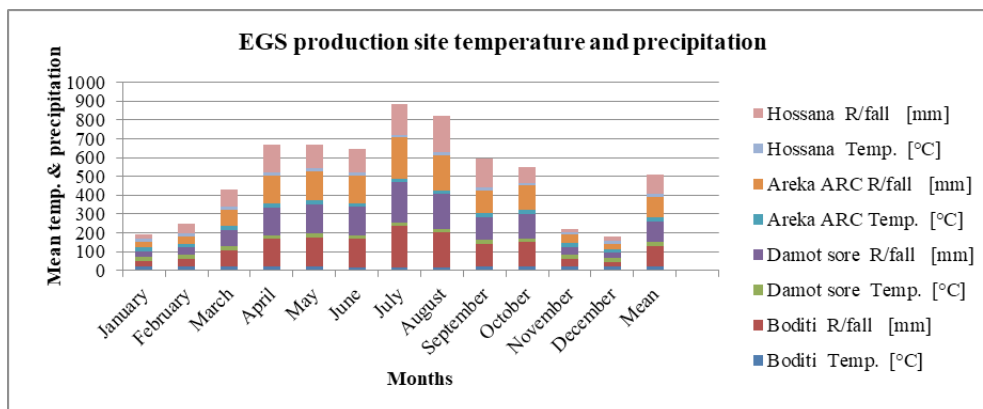


Figure 1: Mean temperature and precipitation of the EGS production site of Areka ARC (2022).



Figure 2: Wheat multiplication.

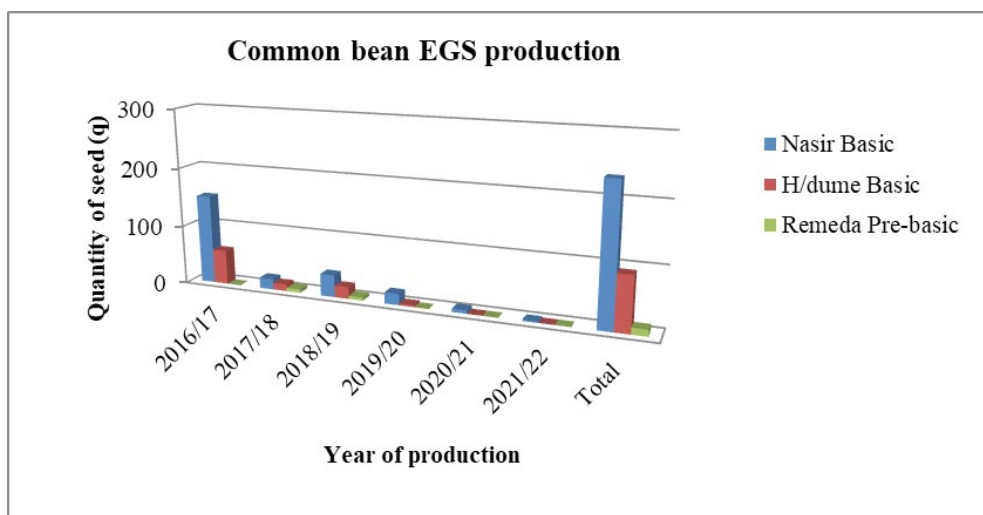


Figure 3: Early generation seed produced (q) by Areka ARC during 2016/17–2021/22.

there is no demand of the seed due to this reason the plan has not been set at that time.

Root and tuber crop early generation seed production

Root and tuber crops represent the highest contribution both in production and consumption and are thus very important for food security. Areka Agricultural Research Center (AARC) is the Enset crop research national coordinating center. The major root and tuber crops EGS produces are Enset and taro in the center.

Early generation seed production of Enset (*Ensete ventricosum* (Welw.) Cheesman) corm and sucker production

A total of 27973 EGS of enset corm and suckers were produced in Areka ARCs from the 2016/17-2021/22 cropping season (Figure 4). The highest share of 7500 corms was produced in 2017/18, whereas the lowest share of 1327 corms was produced in 2018/19. Similar to that of the corm, the highest share of 3988 suckers was produced in 2019/20 and the lowest share of 358 suckers was produced in 2017/18 (Figure 4).

Early generation seed production of Taro (*Colocasia Esculenta* L.)

In the 2016/17–2021/22 cropping seasons, Areka ARCs produced a total of 6015 quintals of EGS of the Taro Boloso-1 variety (Figure 5). The highest share of 1500 quintals of seed was produced for the variety Boloso-1 in 2019/20, whereas the lowest share of 147 quintals was produced in 2021/22 (Figure 5). The graphs of EGS from 2018/19 produced a trend that was upward; however, there is a downward

moment in EGS from 2019/20–2021/22 (see Fig. 5). The production trends of Boloso-1 taro EGS showed ups and downs (Figure 6).

The Challenges of EGS Production

Early generation seed production is challenged by both financial and physical resources (Figure 7). The main challenges for EGS production are:

- There is a scarcity of breeder seed because breeders have no incentive to produce EGS.

- There is a shortage of different types of machinery for different operations, such as land preparation, planting, chemical spray, threshing, and harvesting;

- Lack/shortage of skilled human power that can maintain farm types of machinery, such as tractors, seed cleaners,

- A lack of a functional seed storage facility

- Lack of irrigation facilities (Figure 8).

- Limited demand for EGS of newly released varieties (i.e., weak relationship between research and the agricultural extension system)

- Because of the allocation of an insufficient budget, the EGS production capacity is limited.

- Limited access to EGS

- Scattered fields are a major challenge faced in seed multiplication.

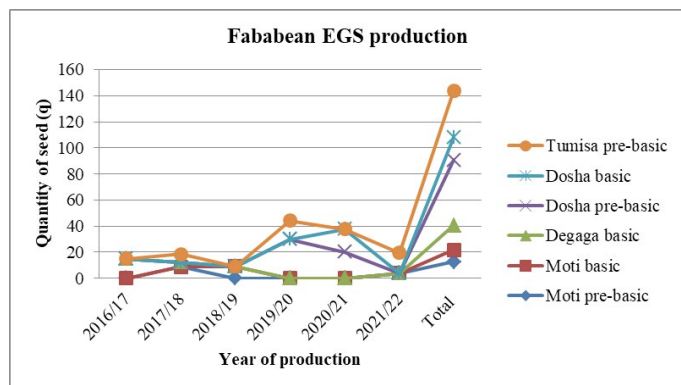


Figure 4: Early generation seed produced (q) by Areka ARC during 2016/17–2021/22.

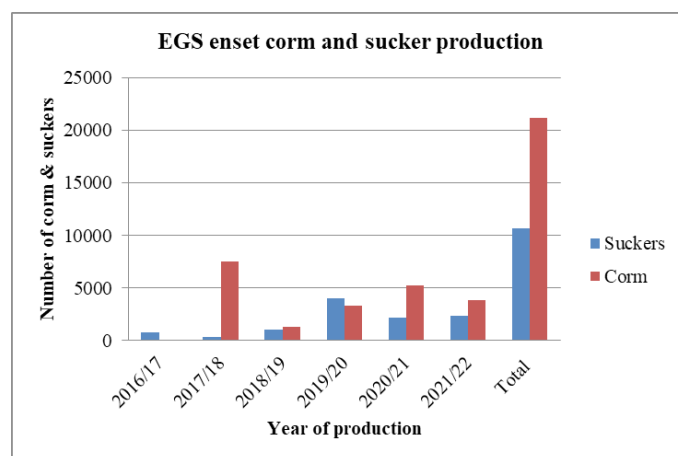


Figure 6: Early generation seed produced (n) by Areka ARC during 2016/17–2021/22.

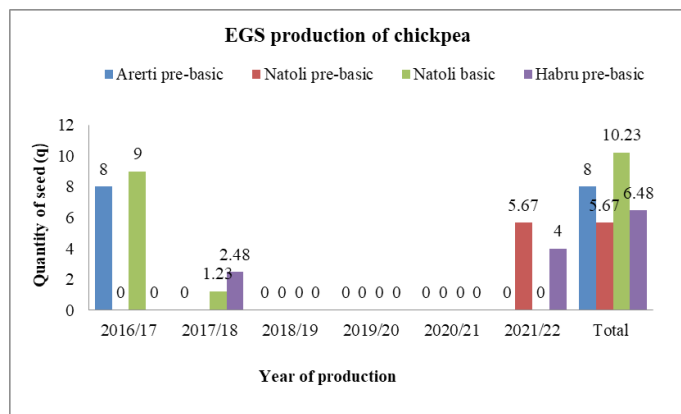


Figure 5: Early generation seed produced (q) by Areka ARC during 2016/17–2021/22.



Figure 7: Enset Corm Multiplication.



Figure 8: Enset Sucker Multiplication.

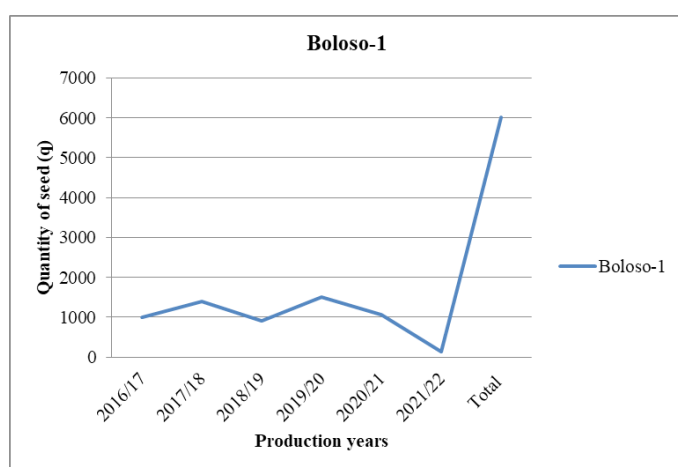


Figure 9: Early generation seed produced (q) by Areka ARC during 2016/17–2021/22.



Figure 10: Taro (Boloso-1) multiplication.

This makes field inspection expensive and time-consuming (Figure 9, Figure 10).

A shortage of strengthened human resource capacity

Opportunities

The main opportunities for EGS production are:

Demand creation for newly released varieties through popularization and demonstration.

Introduce appropriate agricultural technologies (crop diversification, improved cropping systems, integrated crop management, storage management),

Improve the monitoring and evaluation of the EGS system.

Currently, public seed enterprises, private seed companies, seed producer cooperatives, and seed unions are operating.

Fertile land and a conducive climate:

Quality seeds are becoming increasingly popular.

Producer manpower

Farmers are eager to produce improved varieties.

The plan of the government to improve varieties is that to achieve the planned GDP of the country, agricultural production should be doubled. So, the government emphasizes the source of productivity and seeds.

The ambition of universities, research centers, and experts in different sectors is to help farmers with the production of improved varieties.

Summary and Conclusion

Seed is also an important component of agricultural production, and the availability of viable and vigorous seeds at the planting time is very important for achieving the yield target. The use of quality seeds of a variety having high genetic potential (as for the improved varieties) can increase yield. Quality seeds are widely acknowledged to enhance food security and reduce poverty in Africa through increased agricultural productivity. A total of 1253.21 and 511.16 quintals of major cereals and pulse EGS were produced in the 2016/17–2021/22 cropping season, respectively. From 2016/17–2021/22 cropping seasons, the Areka Agricultural Research Center produced a total of 27973 EGS of enset corm and suckers. In the 2016/17–2021/22 cropping seasons, Areka ARCs produced a total of 6015 quintals of taro EGS of the Boloso-1 variety. The challenges are: a lack of incentives for EGS production; a lack of market orientation at the demand-supply interface; limited capacity; allocation of an insufficient budget; scattered fields for mechanization; and opportunities are fertile lands and a conducive environment; quality seeds are becoming increasingly popular; farmers are eager to produce improved varieties; currently, public seed enterprises, private seed companies, seed producer cooperatives, and seed unions are producing. This implies that AARC's capacity to produce early-generation seeds will improve in order to fulfill the existing demand for EGS.

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