

# Impediments to New Improved Maize Variety Testing and Release in Selected Countries in Sub-Saharan Africa

P. S. Setimela<sup>1</sup>, B. Badu-Apraku<sup>2</sup> and W. Mwangi<sup>3</sup>

1. *International Maize and Wheat Improvement Centre, P.O. BOX MP163, Harare, Zimbabwe*

2. *International Institute of Tropical Agriculture, P.M.B 5320 Ibadan, Nigeria*

3. *International Maize and Wheat Improvement Centre, P.O. Box 1041, Village Market-00621 ICRAF House, United Nations Avenue, Nairobi, Kenya*

Received: November 20, 2009 / Accepted: March 30, 2010 / Published: December 1, 2010.

**Abstract:** Before farmers can benefit from new improved maize varieties with novel genetic information, new maize varieties have to undergo performance testing, registration and approval. The registration procedures require that new maize varieties must pass the tests for value for cultivation and use (VCU) and standardized tests for distinctness, uniformity and stability (DUS). To meet the minimum requirements for variety release, public and private sector maize breeding programs routinely assemble breeding nurseries and evaluate variety performance in National and Regional Performance Trials (NRPT) with the objective of generating important agronomic data to identify the best maize varieties for release. In spite of intensive variety evaluation in regional and national trials, only few maize varieties have been registered and released annually in sub-Saharan Africa (SSA) denying farmers access to new improved varieties. The purpose of this study was to identify constraints hampering the registration and release of elite maize germplasm and make recommends on how to quicken the deployment of elite germplasm to smallholders' farmers. A survey was conducted on the varietal testing and release systems in 14 selected countries (Angola, Benin, Ethiopia, Malawi, Ghana, Mali, Mozambique, Nigeria, Tanzania, Kenya, South Africa, Uganda, Zambia, and Zimbabwe) in SSA. The results from the study show that regulations on variety testing and release procedures in the various countries are overlapping and rigid hindering the deployment and commercialization of new improved maize germplasm. The study also showed that varietal release rates fluctuated between countries with South Africa having the highest number of varietal release rates per year and some countries failing to release a single variety per year.

**Key words:** DUS, maize, VCU, variety release, seed regulations, improved varieties.

## 1. Introduction

Worldwide, maize ranks first in terms of production among cereals, just ahead of wheat and significantly ahead of rice. In developing countries economies, maize ranks first [1]. It is projected that the demand for maize by 2020 will far surpass the demand for rice and wheat. The crop has wide uses, as it can be harvested

while it is still green or when it is fully mature as grain. In SSA over 650 million people annually depend on it for their livelihood as source of calories and protein [2]. Smallholder farmers allocate more than 50% of their land to maize to ensure that sufficient maize is harvested as core to family food basket and income security [3].

The variety testing and release regulations in SSA have been identified as one of the major impediments in getting elite maize varieties to the smallholder farmers. The regulations in the different countries were found to overlap and rigid, thus making it difficult to

---

**Corresponding author:** P. S. Setimela, Ph.D., research fields: improving maize seed systems, characterization of maize mega-environments, DNA finger-printing of maize open pollinated varieties, development of maize for drought tolerance. E-mail: Psetimela@cgiar.org.

commercialize new improved maize varieties [4]. To meet the minimum requirements for varietal release, agricultural research institutions routinely assemble breeding nurseries and test new maize genotypes for yield performance in National and Regional Performance Trials (NRPT) with the objective of generating important agronomic data to identify the best varieties for release [5, 6].

The NRPT are professionally managed to minimize variability and ensure the integrity of the results. However, extensive variety testing has been inadequate in speeding up variety releases to benefit the smallholder farmers who still use unimproved varieties [7]. Economic analysis done by the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) found that farmers could lose as much as US\$ 43 million because of the delay in replacing an old variety with a new one. This was demonstrated in one popular sorghum variety, SDS 3220, which was released in Mozambique in 1989, and 11 years later in Tanzania [8]. In spite of massive investments in plant breeding research, the rate of adoption of improved seed in SSA remains low and variable ranging from 5% in Angola to 80% in Zimbabwe partly due to the inefficiency of local seed systems [9].

This study was undertaken in 2007/2008 under the auspices of the drought tolerant maize for Africa (DTMA) project supported by Bill and Melinda Gates Foundation (B&MGF) in order to understand the variety testing and release approaches in DTMA project countries in SSA. The specific objectives of the study were: to summarize the variety release requirements and procedures in these countries; to define the time taken to release elite maize varieties; to identify constraints hampering the release of elite maize germplasm to smallholder farmers; and to propose strategies to accelerate the release of new maize varieties.

## **2. Materials and Methods**

A survey was conducted on the varietal release systems in 14 countries which included 13 DTMA

countries (Angola, Benin, Ethiopia, Ghana, Kenya, Malawi, Mali, Mozambique, Nigeria, Tanzania, Uganda, Zambia, and Zimbabwe) in SSA. Although South Africa is not participating in the DTMA project, it was included as a reference point in the study because it is considered to have an advanced and the most liberal variety release system in SSA. These countries were chosen because maize is the staple food accounting for more than 70% of the cereal land area. The study was conducted between late 2007 and October 2008. It involved completion of questionnaires by national seed authorities (NSA) in each country followed by personal interviews with researchers and reviews of published literature and documents related to variety release. In each country the NSA are responsible for scrutinizing DUS and VCU data submitted for variety release, registering and entering released maize varieties into the national variety catalogue. The questionnaires were designed to capture information on the number of varieties released and registered in the past five years, whether DUS or VCU data are requirement for variety release and registration, if each country has publicized guidelines on procedures for variety release and registration and the frequency that the National Variety Release Committee (NVRC) meets to accept proposals for release. The data were complemented with information from national variety release catalogues, personal interviews with the national seed authorities and FAO statistics.

## **3. Results and Discussion**

### *3.1 Current Status for Distinctness, Uniformity and Stability in DTMA Project Countries*

In the 14 countries surveyed, for a new maize variety to be released, registered and marketed, it must be distinct, uniform and stable (DUS). Malawi is the only country that does not require DUS testing for registration of new maize varieties (Table 1).

The DUS and VCU tests can take as long as one to three years before the data are sufficient to be submitted to the NVRC. Of the 13 DTMA project countries,

**Table 1** Current status of DUS in DTMA project countries including South Africa.

Country	Published DUS guidelines	DUS requirement for maize OPVs	DUS requirement for maize hybrids	DUS requirement for maize inbred lines	Number of traits or characteristics to be measured for DUS	Number of seasons for DUS	Sample size (kg)	Fees to be paid for conducting DUS data per entry (US\$)
Angola	No	Yes	Yes	No	Not specified	2	15	Free
Benin	No	Yes	Yes	No	6	2	5	Free
Ethiopia	Yes	Yes	Yes	Yes	Not specified	Not specified	Not specified	Free
Ghana	Yes	Yes	Yes	Yes	36	2	20	Free
Kenya	Yes	Yes	Yes	Yes	34	2	2	600
Malawi	No	No	No	No	Not specified	2	10	Free
Mali	No	Yes	Yes	No	4	3	5	Free
Mozambique	No	Yes	Yes	No	Not specified	Not specified	Not specified	Free
Nigeria	No	Yes	Yes	No	Not specified	3	Not specified	Free
South Africa	Yes	Yes	Yes	No	37	1	1	\$300
Tanzania	Yes	Yes	Yes	No	20	2	2	\$600
Uganda	Yes	Yes	Yes	Yes	>20	2	2	\$200
Zambia	Yes	Yes	Yes	Yes	68	2	1	\$125
Zimbabwe	Yes	Yes	Yes	No	15-20	1	1	Free

only seven have published guidelines on how the DUS tests must be conducted and which traits should be recorded. Lack of published guidelines for DUS in Angola, Benin, Mali, Mozambique, Nigeria and Uganda makes it difficult for seed companies to collect the necessary data to meet the requirements for DUS. Recording DUS data for three seasons delays the entry of new maize varieties into the market. The number of traits for DUS differs significantly from country to country. The DUS from other countries is not accepted for release which further increases the delay (Table 1). The DUS data have to be collected for each country if a seed company wants to sell seed in other countries.

In Kenya, Mozambique, Zambia and Zimbabwe the breeders are normally required to provide their own DUS information which is compared with the information collected by the National Seeds Authority (NSA). The NSA follows the UPOV maize descriptors to collect DUS data. Zambia requires the highest number of maize descriptors (68) while Mali requires the lowest number (4) (Table 1). The number required by Zambia which is almost twice the number required by South Africa is too high and makes data collection

difficult and time consuming.

### 3.2 Current Status for Value for Cultivation and Use

Of the 13 DTMA project countries surveyed, 10 have published guidelines on how VCU data should be recorded. The countries without published guidelines are Angola, Benin and Mali. South Africa is the only country that does not require VCU data for the registration and marketing of new maize varieties (Table 2). In South Africa, the rationale for not requiring VCU data is based on the fact that market forces should determine the best maize varieties. If a farmer buys a variety that performs poorly from a given seed company, the farmer will not return, therefore the seed company loses that particular customer forever. Lack of published guidelines poses problems to seed companies since it is not clear which important traits should be presented for variety release.

In Benin, Ethiopia, Nigeria and Uganda, the VCU tests range from 2 to 3 seasons whereas Angola requires the data for one season only. In Kenya, Zambia and Tanzania, the NSA is responsible for assembling and conducting National Performance

**Table 2** Current status of value for cultivation and use in DTMA project countries including South Africa.

Country	Published guide lines for VCU	VCU data required	Number of trial sites	Number of seasons	Data from other countries allowed	Number of traits required for VCU	Cost per entry into NPTs (US\$)	On farm data required for release	Number of varieties that can be submitted for registration	Date to submit application for release	Royalties on public material	Varietal registration required
Angola	No	Yes	3	1	Yes	Not specified	No NPTs	Yes	No limit	Deadline not set	No	Yes
Benin	No	Yes	25	3	Yes	7	No NPTs	No		On deadline	No	Yes
Ethiopia	Yes	Yes	3 to 5	2 to 3	No	10	\$100	Yes	3 per ecology	May	No	Yes
Ghana	Yes	Yes	6	2	No	36	No NPTs	No	On deadline	On deadline	No	Yes
Kenya	Yes	Yes	6	2	No	Not specified	\$500	Yes	No limit	Deadline not set	Yes	Yes
Malawi	Yes	Yes	5	2	No	15	No NPTs	Yes	No limit	Oct.-Nov	No	Yes
Mali	No	Yes	5	2	Yes	5	\$1875	Yes	No limit	No deadline set	No	Yes
Mozambique	Yes	Yes	3 to 5	3	Yes	13	No NPTs	Yes	No limit	No deadline	Yes	Yes
Nigeria	Yes	Yes	3	2 to 3	No	Not specified	No NPTs	Yes	No limit	No	No	Yes
South Africa	No	No	No	No	No	No	No NPTs	No	No limit	Aug.	Yes	Yes
Tanzania	Yes	Yes	3	2		6	\$600	Yes	No Limit	Sep.	No	Yes
Uganda	Yes	Yes	5	3	Yes	Not specified	\$150	Yes	No limit	Apr. and Sep.	No	Yes
Zambia	Yes	Yes	6	2	Yes	10	\$125	No	No Limit	Aug.	No	Yes
Zimbabwe	Yes	Yes	5	2	Yes	5	No NPTs	Yes	2	Oct.	Yes	Yes

Trials (NPTs) from which the VCU data is obtained. In Kenya, Ghana, Uganda and Zambia the VCU tests are recorded for 5 to 6 locations depending on the mega-environments for which the variety is being recommended. In Benin, the VCU data have to be collected across 25 locations making it very expensive for a seed company to conduct VCU trials in all these locations. Reducing the number of locations will make it easier and cheaper for seed companies to test their varieties for release. The VCU data are collected on important agronomic traits such as grain yield, diseases resistance and plant height. On the average, 10 to 15 agronomic traits are required (Table 2). Of the countries surveyed, Ghana requires the highest number of agronomic traits (36) while Zimbabwe and Mali require the lowest number (5 each). Recording of agronomic traits is time consuming and only important

ones should be collected or not collected at all as is the case in South Africa.

Zimbabwe and Kenya have a stipulated number of varieties that can be registered at one time by a seed company per year (Table 2). On the other hand, Ethiopia allows only 3 varieties per agro-ecological zone to be registered by a seed company. The limit on the number of maize varieties that a seed company can register per year is one of the major bottlenecks as it limits the number of maize varieties that may enter the market in a given year. On the other hand, different mega-environments require different types of germplasm e.g. early maturing germplasm for lowlands and medium maturing for the mid-altitudes.

### 3.3 Maize Varietal Releases

Table 3 shows an estimated number of maize varieties

released between 2002 and 2006. Nearly 600 maize varieties were released from the private and the public sector. The varietal release rates varied between countries. South Africa had the highest average number of varietal release rates at 60 per year followed by Kenya with 16 varieties per year. On the other hand, Ghana, Nigeria, Uganda and Mozambique in some years failed to release a single maize variety. Compared to other countries, South Africa, Kenya, Zambia, and Zimbabwe have been more regular in releasing varieties per year.

The varietal release rates show the stage of the development of the seed industry in these countries. A country like South Africa with a mature seed industry has very high rate of variety releases per year contrasted with Benin which has no seed companies resulting in very low rates of variety releases per year. Region-wise, southern Africa which includes South Africa had the highest varietal release rates and highest adoption rate (52%) compared to West Africa (4%) [9]. Although a number of maize varieties have been released in several countries, the time taken to release them varies. South Africa had the shortest time for variety release and Kenya the longest (Table 4).

In Kenya, more time is taken because the variety has to be tested by the breeder first in multi-locational environmental trials (METs) and only when the breeder is satisfied with the performance of the variety that it can be put into National Performance Trials (NPTs). The production of seed starts once the breeder is convinced that his/her variety will make it through the NPTs. In South Africa, only DUS data are required whereas in Kenya, both DUS and VCU data are required for the release. In most of the countries, it takes two seasons to produce enough quantities of foundation seed that will lead to certified seed production. In Malawi, an increase in breeder or foundation seed production is not allowed before a variety is registered.

#### **4. Conclusions and Recommendations**

This study has shown that for any new maize variety to be released and registered for distribution, it must be distinct, uniform and stable (DUS) and have value for cultivation and use (VCU). The long delay between variety development, registration and the release constitutes a major constraint to increased maize production and productivity. The seed laws are very rigid and do not allow the use of data from one country to another with similar agro-ecology. Based on the findings of the study, the following recommendations are made to improve the varietal release rates in the DTMA Project countries in SSA.

##### *4.1 Regional Harmonization of Seed Laws*

The three regions (eastern, southern and West Africa) will benefit from free flow of germplasm across national boundaries if the regional variety release process is harmonized. Maize varieties released in one country should be considered automatically released in other countries with similar ecologies. Megaenvironments cut across country boundaries and adaptation zones. They are not country specific so varieties should be released based on mega-environments to create a larger seed market and quicken variety release.

##### *4.2 Simplification of Variety Testing*

A number of agronomic and DUS data are required for variety release. Registration should be simplified so that only important VCU and DUS information would be required to distinguish the new variety from the others. The DUS information should be from one season since DUS is not affected much by the environment. DUS testing should be conducted along with METs to shorten time of variety release.

##### *4.3 Promotion of the Use of Breeders' Own Data*

Breeders' own data should be used to support variety release thereby eliminating the need for NPTs. The number of locations required for release should be few and emphasis should be on locations where the variety will be recommended for production.

**Table 3** Estimated number of maize varieties by type released by public and private breeding programs in DTMA Project countries including South Africa, 2002-2006.

Country	Number of varieties released per year					Total number of varieties released from 2002-2006
	2002	2003	2004	2005	2006	
Angola	5	3	7	6	8	29
Benin	2	0	0	3	2	7
Ethiopia	4	0	6	8	0	18
Ghana	0	0	0	0	0	0
Kenya	10	22	25	21	4	82
Malawi	8	5	1	3	0	17
Mali	0	0	0	0	0	0
Mozambique	0	4	2	0	0	6
Nigeria	0	4	0	2	0	6
South Africa	68	67	79	69	59	342
Tanzania	2	3	4	0	0	9
Zambia	12	9	11	7	15	54
Uganda	0	0	0	0	0	0
Zimbabwe	2	5	4	3	8	22
Total	113	122	139	122	96	592

**Table 4** Time taken to release a maize variety in selected DTMA Project countries, including South Africa.

Country	Actual time to seed release (years)			Time from release to time seed is available to farmers in significant quantities (years)
	Mean	Min	Max	Mean
Kenya	3.1	1.5	6	2.4
Malawi	3	2	7	1.9
Tanzania	2.2	1	3	2
Uganda	2.2	1	4	2.1
Zambia	2.1	1	3.5	2.5
Zimbabwe	2.2	1	3	2.4
South Africa	2	2	2	2.5
Ghana	2	2	2	2
Nigeria	3	4	3	0.03

Source: DTMA seed sector survey, 2007/2008.

#### 4.4 Production of Breeders' Seed

Breeders should embark on limited breeder seed production and marketing instead of waiting until the variety is fully released as this prolongs the time taken for a variety to reach farmers.

#### 4.5 Variety Release Guidelines

In some cases the National Variety Release Committee (NVRC) rejects the variety and asks the breeder to improve a specific trait thus delaying the release of a new variety. The decision to release a variety should be based on merit and uniqueness. The new variety should contribute new trait(s) that the existing one does not possess. Governments should therefore develop variety release guidelines in those

countries in which they are lacking to ensure fairness and transparency in the variety release process.

## References

- [1] FAOSTAT, Statistical data base of Food and Agricultural Organization of the United Nations, Rome, Italy, 2002.
- [2] FAOSTAT, Statistical data base of Food and Agriculture Organization, available online at: <http://faostat.fao.org/faostat/collectionsubset>.
- [3] M. Bänziger, Annual Report: The Southern African Drought and Low Soil Fertility Project, CIMMYT, Harare, 1998.
- [4] E. Zulu, Experiences with variety testing, registration, and release, in SADC region, in: Regional Technical Meeting for Formulation of SADC Regional Variety Release System, 7-9 April, Gaborone, Botswana, 2003.
- [5] J. Wobil, Seed security issues in southern Africa, in: Proceedings of the International Workshop on Seed Security for Food Security, Florence, Italy: Rome and Accademia dei Georgofili, 1998, pp. 217-226.
- [6] S. Lanteri, L. Quagliotti, Problems related to seed production in the Africa region, *Euphytica* 96 (1997) 173-183.
- [7] B. Vivek, M. Banziger, K.V. Pixley, Characterization of maize germplasm grown in eastern and southern Africa: Results of the 2003 regional trials coordinated by CIMMYT, Harare, Zimbabwe, 2004.
- [8] M. Mgonja, E. Monyo, D. Rohrbach, et al., Regional plant breeding and variety registration: A case study of southern Africa, in: D. Rohrbach, J. Howard (Eds.), *Seed Trade Liberalization in Sub-Saharan Africa*, Matopos Research Station, Bulawayo, 2002.
- [9] A.S. Langyintuo, W. Mwangi, A.O. Diallo, et al., An analysis of the bottlenecks affecting the production and deployment of maize seed in eastern and southern Africa, Harare, Zimbabwe, CIMMYT, 2009.