

Variety Testing and Release Approaches in DTMA Project Countries in sub-Saharan Africa

Peter S. Setimela, Baffour Badu-Apraku and Wilfred Mwangi



The International Maize and Wheat Improvement Center, known by its Spanish acronym, CIMMYT® (www.cimmyt.org), is an international, not-for-profit research and training organization that, together with partners in over 100 developing countries, works to increase food security, improve the productivity and profitability of farming systems, and sustain natural resources in the developing world. · The center's outputs and services include improved maize and wheat varieties and cropping systems, the conservation of maize and wheat genetic resources, and capacity building. CIMMYT belongs to and is funded by the Consultative Group on International Agricultural Research (CGIAR) (www.cgiar.org), and also receives support from national governments, foundations, development banks, and other public and private agencies.

© International Maize and Wheat Improvement Center (CIMMYT), 2009. All rights reserved. The designations employed in the presentation of materials in this publication do not imply the expression of any opinion whatsoever in the part of CIMMYT or its contributory organizations concerning the legal status of any country, territory, city, or area, or of its authorities, or concerning the delimitation of its frontiers or boundaries. CIMMYT encourages fair use of this material. Proper citation is requested.

Correct citation: Setimela P.S., B. Badu-Apraku, and W. Mwangi. 2009. *Variety testing and release approaches in DTMA project countries in sub-Saharan Africa*. Harare, Zimbabwe, CIMMYT.

AGROVOC Descriptors: Grain crops, Maize, Varieties, Seed testing, Quality, Seed certification, Seed industry
AGRIS Category Codes: F01
Dewey Decimal Classif. 633.1047 67
ISBN: 978-92-9059-252-5

Printed in Kenya

Variety Testing and Release Approaches in DTMA Project Countries in sub-Saharan Africa

Peter S. Setimela, Baffour Badu-Apraku and Wilfred Mwangi

Contents

List of Tables	ii
List of Figures	ii
Executive Summary	iii
Introduction.....	iii
Major findings	iii
Variety release regulations	iii
Varietal releases	iii
Recommendations	iv
Concluding remarks	v
Acronyms and Abbreviations	vi
Introduction	1
1. Importance of maize in sub-Saharan Africa (SSA).....	1
2. Data sources	4
3. Summary of current status of variety release and registration in DTMA project countries in SSA	4
4. Current status for distinctness, uniformity and stability (DUS) in DTMA project countries	5
Current status of value for cultivation and use in DTMA Project countries in SSA	8
Maize varieties release by region.....	13
Public and private sector releases.....	14
Type of germplasm released in DTMA project countries in SSA.....	15
Summary: organization and structure of variety release systems by country	16
Angola.....	16
Benin.....	17
Ethiopia	17
Ghana.....	18
Kenya	19
Malawi	20
Mali	21
Mozambique	22
Nigeria	22
Tanzania	24
Uganda.....	25
South Africa.....	26
Zambia.....	27
Zimbabwe.....	28
Conclusions and recommendations	29
References	31

List of Tables

Table 1.	Estimated maize seed supply and need in eastern and southern Africa	2
Table 2.	Estimated maize seed demand and supply in the selected countries in West Africa.	3
Table 3.	Current seed control in the DTMA project countries including South Africa.....	5
Table 4.	Current status of DUS in DTMA project countries including South Africa.....	7
Table 5.	Current status of value for cultivation and use in DTMA Project countries and South Africa.	11
Table 6.	Average number of varieties released per year in DTMA Project Countries including South Africa, 2002–2006.....	12
Table 7.	Time taken to release a maize variety in selected DTMA Project countries, including South Africa.	12
Table 8.	Estimated number of maize varieties by type released by public and private breeding programs in DTMA Project countries including South Africa, 2002–2006.	15
Table 9.	The number of varieties tested and released by the KEPHIS.	19

List of Figures

Figure 1.	Mother-Baby Trial design to evaluate maize cultivars by researchers and farmers.	9
Figure 2.	The average maize varieties releases by region 2002–2006.....	13
Figure 3.	Percentage of public and private seed sector maize releases in DTMA Project countries including South Africa, 2002–2006.....	14
Figure 4.	Variety release channel in Angola.....	16
Figure 5.	Variety release channel in Ethiopia.	17
Figure 6.	Variety release channel in Ghana.....	18
Figure 7.	Variety release channel in Kenya.	20
Figure 8.	Variety release channel in Malawi.	21
Figure 9.	Variety release channel in Mali.	21
Figure 10.	Variety release channel in Mozambique.....	22
Figure 11.	Variety release channel in Nigeria.	24
Figure 12.	Variety release channel in Tanzania.	25
Figure 13.	Variety release channel in Uganda.....	26
Figure 14.	Variety release channel in Zambia.....	27
Figure 15.	Variety release channel in Zimbabwe.....	28

Executive Summary

Introduction

This report presents a summary of variety testing and release regulations in DTMA project countries in sub-Saharan Africa (SSA). In order to understand these approaches a study was undertaken in 2007 under the auspices of the Drought Tolerant Maize for Africa (DTMA) project funded by the Bill and Melinda Gates Foundation (B&MGF). The objectives of the study were to:

- Define the time taken to release elite maize varieties.
- Summarize the variety release requirements and procedures in DTMA countries in SSA.
- Identify constraints hampering the release of elite maize varieties to smallholder farmers.
- Propose strategies to hasten the release of new maize varieties.

The study covered all the DTMA project countries: Angola, Benin, Ethiopia, Malawi, Ghana, Mali, Mozambique, Nigeria, Tanzania, Uganda, Kenya, Zambia, and Zimbabwe. South Africa was included as a reference point because it is considered to have the most advanced and liberal seed system in SSA.

The data for the study were collected in 2007/2008 through a survey of 13 selected national seed authorities (NSA). The questionnaire for the survey was sent out to the NSAs followed by discussions with agricultural researchers, and the revision of published information on variety release guidelines and procedures for each country. The data were also complemented by information from national variety release catalogues wherever possible.

Major findings

Variety release regulations

The results from the study show that for new maize varieties to be marketed they must be registered. The registration process requires that tests for distinctiveness, uniformity and stability (DUS) and value for cultivation and use (VCU) be conducted first before registration. The registration establishes legal ownership of the new maize variety. The DUS and the VCU tests can take between one and three years before sufficient data are available for variety registration. The seed laws for variety testing and release govern seed production, certification, marketing, import and export of maize seed. The seed laws on variety testing and release among the 13 countries are variable and inconsistent. The variability and inconsistency of the seed laws make it costly for seed companies to release and market new maize varieties. A new maize variety must be tested each time it is to be marketed in the respective countries, even if it is developed for sale across a wide range of agro-ecologies. In each country, a National Variety Release Committee (NVCR) makes a decision to release or to reject a new variety based on the data compiled in the release proposal. In a number of situations, the public sector was found to be dominant in the variety release committee meetings and there were complaints that there was a bias in the scrutiny of varieties to the disadvantage of those from the private sector. In some cases the variety was not released based on its merit and uniqueness.

Varietal releases

The results also show that between 2002 and 2006 nearly 600 maize varieties were released by the private and the public sectors. The varietal release rates were highest in southern Africa including

South Africa followed by eastern Africa, and lastly, West Africa. Southern Africa had the highest adoption rate of new improved maize varieties while West Africa had the lowest adoption rate. The private seed sector dominated the varietal release rates in South Africa, Malawi, Kenya, Tanzania, Zambia, and Zimbabwe, indicating the strong presence of the private sector. White maize hybrids dominated the maize varietal releases between 2002 and 2006.

Recommendations

- Promotion of regional standards for plant breeders rights (PBRs): Regional standards for PBRs should be promoted to allow plant breeding programs to generate income from the products of their research through royalties. This will provide an opportunity for the private and the public sectors to benefit from the product of research and encourage more investments in variety improvement. The study therefore recommends the development of PBRs in each country.
- Regional harmonization of seed laws: The three regions—eastern, southern and western Africa—will benefit from free flow of germplasm across national boundaries if the regional variety release process is implemented. Maize varieties released in one country should be regarded as automatically released in the other countries with similar ecologies. Mega-environments cut across country boundaries and adaptation zones are not country specific so varieties should be released based on mega-environments to create a larger seed market and quicken variety release. Therefore this study supports regional variety release based on mega-environments.
- Promoting the use of data from other countries: Only a few countries accept data from other countries for variety release. Testing should not be mandatory for varieties already released in other countries if the recommendation domain is the same. If data from other countries are accepted for variety release this will eliminate re-testing of varieties from country to country therefore saving resources and quickening variety release.
- 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 tests should be conducted along with multi-environment trials (METs) to shorten time to variety release.
- Promotion of the use of breeders' own data: Breeders' own data should be used to support variety release thereby eliminating the need for national performance trials (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. Production of breeders' seed: Breeders should embark on limited seed production and marketing instead of waiting until the variety is fully released, as this prolongs the period taken for the variety to reach farmers.
- Variety release guidelines: In some cases the NVRC rejects the variety and asks the breeder to improve a specific trait delaying the release of a new variety. The determination to release should be based on merit and uniqueness. The new variety should contribute new trait(s) that the existing one does not possess. Therefore, governments should develop variety release guidelines in those countries where these are lacking to ensure fairness and transparency in the variety release process.

- Frequency of meetings of NVRC: The variety release meetings have been irregular in some countries. This study encourages governments to ensure that NVRC meet regularly and funds should be made available for the meetings.

Concluding remarks

The survey results show that variety testing and release committees differ a great deal among countries, including in their composition. In a number of situations, the public sector dominates the variety release committee meetings. The difficulties with existing variety releases system have resulted in delayed access by farmers to new maize varieties. The system has allowed few varieties to be released; it is costly and duplicative, as the same variety must be tested in all countries where it is being targeted for marketing. The return on investment is also delayed as seed companies have to wait for a long period before they can enter the seed market while their variety is undergoing testing prior to release.

Acronyms and Abbreviations

AREX	Agricultural Research and Extension, Zimbabwe
B&MGF	Bill and Melinda Gates Foundation
CIMMYT	Centro Internacional de Mejoramiento de Maiz y Trigo / International Maize and Wheat Improvement Center
CRI	Crops Research Institute, Ghana
CSIR	Council for Scientific and Industrial Research, Ghana
DAR	Department of Agricultural Research, Malawi
DSS	Department of Seed Service, Mozambique
DTMA	Drought Tolerant Maize for Africa
DUS	Distinctness, Uniformity and Stability
EIAR	Ethiopian Institute of Agricultural Research
FAO	Food and Agriculture Organization of the United Nations
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IER	Institut d'Economie Rurale du Mali
IIAA	Instituto de Investigação Agronómica de Angola
IIAM	Instituto de Investigação Agrária de Moçambique
INRAB	Institut National des Recherches Agricoles du Benin
ISTA	International Seed Testing Association
KEPHIS	Kenya Plant Health Inspectorate Service
MBT	Mother-baby trials
MET	Multi-environment trial
MoA	Ministry of Agriculture
MOFA	Ministry of Food and Agriculture
NARS	National agricultural research systems
NCRP	Nationally Coordinated Research Project
NCVLBRRC	National Crop Varieties and Livestock Breeds Registration and Release Committee
NPT	National performance trials
NPTC	National Performance Trials Committee
NSA	National Seed Authority
NGO	Non-governmental organization
NVPT	National variety performance trial
NVRC	National Variety Release Committee
PBRs	Plant Breeders' Rights
SADC	Southern African Development Community
SARI	Savanna Agricultural Research Institute
SCCI	Seed Control Certification Institute
SSA	Sub-Saharan Africa
OPV	Open-pollinated variety
SSSN	SADC Seed Security Network
TOSCI	Tanzania Official Seed Certification Institute
TSC	Technical Sub-Committee
UPOV	International Union for the Protection of New Plant Varieties
USAID	United States Agency for International Development
VCU	Value for Cultivation and Use
VRC	Variety Release Committee

Introduction

1. Importance of maize in sub-Saharan Africa (SSA)

Maize ranks first worldwide in terms of production among cereals, just ahead of wheat and significantly ahead of rice. In developing countries' economies, maize ranks first (FAO 2001). 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 (FAOSTAT 2006). It plays a major role as a food security crop and socio-economic stabilizer in many countries. 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 (Bänziger et al. 2006).

Maize is a versatile crop that adapts to a wide range of environments. The plant grows at a latitude ranging from the equator to areas that are 3000 m above sea level, under heavy rainfall, semi-arid conditions, temperate zones and tropical climates (Dowswell et al. 1996). The diverse environment in which maize is grown reflects its adaptability to a wide range of environments and suitability to various cropping systems.

In the nine DTMA project countries in eastern and southern Africa, maize is grown on more than 12 million hectares. Ethiopia accounts for more than 1.7 million hectares whereas Zambia accounts for the smallest area of about 0.6 million ha (Table 1). By region, eastern Africa accounts for the largest hectareage (Table 1). During the 2006/07 season an estimated 103,600 t of improved maize was marketed in eastern and southern Africa. Improved open-pollinated varieties (OPVs) of maize accounted for about 23,000 t while hybrid maize seed was estimated at 80,000 t. The rest of the seed was sourced from the informal seed sector through seed exchanges and recycling of OPVs and hybrids (Table 1).

By region, eastern Africa accounts for the largest sales of hybrid seed. Kenya accounted for the largest hybrid seed sales in eastern Africa while in southern Africa, Zimbabwe accounted for the largest sales. The seed need ranges from 64,000 t in Tanzania, to 14,000 t in Zambia. Compared to the adoption rates recorded in 2001 by Hassan et al., Zambia and Malawi had the highest adoption rates of improved maize seed. The high adoption rate in Malawi is attributed to the large number of seed companies that are now operating in the country (Langyintuo et al. 2008). Seed companies are more eager to promote the use of improved seed as the use of more improved seed leads to more profits. Looking at the seed sales in 2006/2007, more hybrid seed was sold compared to OPVs. The high sales of maize hybrid seed may be attributed to seed companies as they can derive more profit compared to OPVs. Additionally, the yield penalty for recycling hybrids is higher in comparison to OPVs.

Table 1. Estimated maize seed supply and need in eastern and southern Africa

Region/country	Maize area (x mil ha)	Estimated seed need (x 1000 MT) ¹	Improved OPV maize seed sales (x 1000 MT)			Hybrid maize seed sales in 2006/07 (x 1000 MT)	Adop- tion rate 2006/07 (as % of maize area) ²	Adjusted adoption rate in 2006/07 (as % of maize area) ³
			2004/05	2005/06	2006/07			
Eastern Africa	6.6	161.8	4.0	3.5	11.1	42	33 (23)	37
Ethiopia	1.7	42.4	0.4	0.4	2	6.2	19 (8)	21
Kenya	1.6	38.9	0.6	0.1	1.7	26.3	72 (71)	74
Tanzania	2.6	64	0.6	2	3.9	7.3	18 (4)	22
Uganda	0.7	16.5	2.3	1	3.5	2.2	35 (9)	54
Southern Africa	5.4	133.4	9.3	9.8	12	38.5	38 (28)	52
Angola	0.8	19.3	0.8	0.1	0.8	0.2	5 (12)	10
Malawi	1.4	35.3	5.2	4.5	5.4	2.5	22 (14)	50
Mozambique	1.2	30.3	1.2	2.2	3.1	0.2	11 (9)	22
Zambia	0.6	14.1	0.3	1	0.5	9.7	73 (23)	81
Zimbabwe	1.4	34.4	1.8	2.1	2.2	25.9	80 (82)	93
Total/average	12.0	295.1	13.3	13.3	23.1	80.5	35(26)	44

Note: ¹Estimate based on area and planting rate of 25 kg/ha.

²In parentheses are figures observed in 1997 by Hassan et al. (2001). Only seed sales in 2006/07 were used in the estimation.

³Adjusted for OPV sales in 2004/05, 2005/06 and 2006/07 assuming that similar quantities purchased in the first two years were recycled in 2006/07. That is, total improved OPV seed planted is aggregated over 2004/05, 2005/06 and 2006/07. Note that total area under improved maize varieties is 4.2 million ha (0.92 million ha under OPV) before and 5.3 million ha (2 million ha under OPV) after adjustment with previously purchased OPV seed.

Source: DTMA seed sector survey, 2007/2008

The estimates of maize seed demand and supply from 1997 to 2006 are shown in Table 2, for selected countries in West Africa. The total seed demand outweighs the seed supply from the formal seed sector in the selected countries in West Africa. Compared to eastern and southern Africa the formal seed sector in West Africa supplied more OPVs than hybrids. The supply of more OPVs in West Africa indicated that there are few seed companies in the region compared to eastern and southern Africa. In Nigeria, the seed supply accounted for only about 46%, in Ghana 11% and only 3% Mali. In terms of the maize area, Nigeria accounted for the largest area at 3,567,000 hectares, with Mali being the smallest at 309,000 ha.

Table 2. Estimated maize seed demand and supply in the selected countries in West Africa.

Country	Maize area (x 000 ha) (1997– 2006 average) ¹	Estimated seed demand (x 000mt) ²	Seed supply from the formal seed sector (x 000mt)		
			OPVs	Hybrids	% of total requirement
West Africa	5273	131.84	25.84 ⁴	17.98 ⁵	33.2 ¹
Benin ³	651	16.28	–	–	–
Nigeria ³	3567	89.18	23.60 ⁶	17.96 ⁶	46.6
Ghana ³	746	18.65	2.00 ⁷	0.01 ⁸	10.8
Mali ³	309	7.73	0.23	–	3.0

Note: ¹ Source: FAOSTAT 2008.

² Estimated based on a planting requirement of 25 kg/ha.

³ Estimates are computed over the period 1997–2006.

⁴ Estimate for West Africa excludes Benin.

⁵ Estimate for West Africa excludes Benin and Mali.

⁶ Seed supply by the seed companies formal suppliers of the Maize Association of Nigeria (MAAN)

⁷ Source: Ewool, 2007

⁸ Source: Alhassan and Bissi 2006.

Source: DTMA seed sector survey West Africa, 2007/2008.

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 were rigid, thus making it difficult to commercialize new improved varieties (Zulu et al. 2003). To meet the minimum requirements for variety release, agricultural research institutions routinely assemble breeding nurseries and test variety performance in national and regional variety trials with the objective of generating important agronomic data to identify the best varieties for release (Wobil 1997; Lanteri and Quagliotti 1997).

These trials 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. 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 a popular sorghum variety, SDS 3220, which was released in Mozambique in 1989, and 11 years later in Tanzania (Mgonja et al. 2002). Despite 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 (Table 1), partly due to the inefficiency of local seed systems.

This study was undertaken in 2007/2008 under the auspices of the 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:

- Define the time taken to release elite maize varieties;
- Summarize the variety release requirements and procedures in DTMA countries in SSA;
- Identify constraints hampering the release of elite maize germplasm to smallholder farmers; and
- Propose strategies to hasten the release of new maize varieties.

This report is organized as follows: Section 1 gives an introduction to the study while section

2 discusses the sources of the data. This is followed by a presentation of the summary of current status of variety release and registration in section 3. Section 4 presents the summary of variety release systems in each DTMA country. The report ends with the conclusions and recommendations in section 5.

2. Data sources

A survey was conducted on the varietal release systems in 14 countries which included 13 DTMA countries (Angola, Benin, Ethiopia, Malawi, Ghana, Mali, Mozambique, Nigeria, Tanzania, Kenya, 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 systems in SSA. 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. The data were complemented with information from national variety release catalogues, personal interviews with the national seed authorities and FAO statistics.

3. Summary of current status of variety release and registration in DTMA project countries in SSA

In the 14 countries surveyed, it was found that for a new maize variety to be released, registered and marketed, it must be distinct, uniform and stable, and have value for cultivation and use (VCU). The NSA along with National Variety Release Committee (NVRC) determines if the new maize varieties are DUS and meet the criteria for VCU in the respective countries. 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. In those countries that have plant breeders' rights (PBRs), this process establishes legal ownership of the new variety (Table 2). The NVRC is mostly composed of representatives from national agricultural research systems (NARS), seed companies, and universities. In most of the countries the NSA is responsible for convening and chairing the NVRC meetings. On average, the NVRC meets once a year except in Uganda where it meets twice a year to evaluate and approve variety releases. It is only in Malawi that it is possible for seed companies to call for special variety release meetings if they want to release a variety before or after the annual meeting for variety release has been held. In this case, a seed company has to provide financial support for the meeting. Due to financial constraints, the committee may not meet for several years. There are no incentives given and the membership is on voluntary basis. This may explain why the committee meets only once a year. The process of variety release worked well when all varieties were derived from national breeders or a single company. The liberalization of the seed market and expansion in sources of new maize varieties has brought about questions on the fairness and efficiency of the system.

The seed laws for variety release among the 13 DTMA countries have high degree of heterogeneity and inconsistency. Seed laws govern production, certification, marketing, import and export of seed. Of the 13 countries studied, only a few follow the standards set by the International Union for the Protection of New Plant Varieties (UPOV) and the International Seed Testing Association (ISTA) (Table 3). UPOV is an international organization that aims to protect new plant varieties with intellectual property rights including plant breeders' rights while ISTA sets the standards for seed testing and certification. Membership of these organizations is costly and only few countries can afford to pay their annual membership fees.

The variety release procedure is cumbersome and delays the introduction of new maize varieties among countries. The process of variety release is costly for seed companies as the same variety has to be tested each time it is released in another country, even if that country has a similar agro-ecology. Retesting in a similar ecology in another country delays the return on the investment made by seed companies because the time required for a new variety to enter the seed market is prolonged. Even within the same country, the release process delays the registration of new varieties because of the number of seasons required to collect VCU and DUS data. The delay in the time for variety release denies farmers access to new improved varieties. This is because choices become limited in the seed market and farmers continue to grow seed of old varieties.

Due to the unpredictable nature of the plant breeding process, varietal release rates are often not regular, particularly in those countries where the guidelines are not very transparent and the NVRC rarely meets. The varietal release rates indicate the success of the maize breeding programs in the country.

Table 3. Current seed control in the DTMA project countries including South Africa.

Country	Plant Breeders' Rights	Member of ISTA	Member of OECD
Angola	No	No	No
Benin	No	No	No
Ethiopia	Yes	No	No
Ghana	No	No	No
Kenya	Yes	Yes	Yes
Malawi	No	Yes	Yes
Mali	No	No	No
Mozambique	Yes	No	No
Nigeria	No	No	No
South Africa	Yes	yes	yes
Tanzania	Yes	No	No
Uganda	No	No	No
Zambia	Yes	Yes	Yes
Zimbabwe	Yes	Yes	Yes

Source: DTMA National variety testing and release survey 2007/2008

4. Current status for distinctness, uniformity and stability (DUS) in DTMA project countries

In the 13 DTMA countries surveyed, a new maize variety must be listed in the national variety catalogue before it can be marketed. For a new variety to be registered, its DUS must be known. The DUS in countries that have PBRs establish legal ownership of the variety. Of 13 DTMA project countries, only seven have published guidelines on how the DUS tests must be conducted and which traits should be recorded. Malawi is the only country that does not require DUS testing for registration of new maize varieties (Table 3). 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. In most countries, the DUS is conducted solely by the NSA which makes it easier as NSA knows the data that should be collected. A seed company is only required to submit a sample of seed which will be grown by NSA for the DUS and also as a reference sample.

The DUS tests are mostly conducted by NSAs. The DUS tests vary from one to three seasons depending on the country. Nigeria and Mali require that the DUS test be conducted for a minimum of three seasons while Zimbabwe requires only one season. The DUS traits are not affected by the environment and one season is usually sufficient to provide the necessary data to demonstrate that the new variety is distinct and uniform. As far as stability is concerned, it may be observed through the years as it is done in South Africa. Recording DUS data for three seasons delays the entry of new maize varieties into the market. The DUS from other countries is not accepted for release which further increases the delay (Table 4). The DUS data have to be collected for each country if a seed company wants to expand their market to 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 NSA. The NSA follows the UPOV maize descriptors. Zambia records the highest number of maize descriptors (68) and Mali the lowest (4) (Table 4). The number recorded by Zambia is much too high and thus makes data collection difficult.

In Zimbabwe and South Africa the DUS information is recorded only on hybrids and OPVs. On the other hand Ghana, Kenya and Zambia require that DUS information should also be recorded on both hybrids and inbred lines. Recording of DUS on inbred lines and hybrids is costly in terms of time and resources. Seed companies market only hybrid seed and it is usually difficult for other companies to know the inbred combinations of a particular hybrid. This renders DUS for inbred lines valueless.

In, Kenya, South Africa, Tanzania, Uganda and Zambia, the DUS tests are conducted at a fee. Tanzania and Kenya have the highest fees while Zambia records the lowest. The fees may discourage seed companies from submitting their samples for DUS. On the other hand, the Seed Control and Certification Institute (SCCI) in Zambia considers the fees insufficient to cover the cost of conducting the DUS tests.

Table 4. Current status of DUS in DTMA project countries including South Africa.

Country	Published DUS Guidelines	DUS requirement for 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

Source: DTMA National variety testing and release survey 2007/2008

Current status of value for cultivation and use in DTMA Project countries in SSA

Of the 13 DTMA project countries surveyed, 10 have published guidelines on how VCU data should be recorded. Those that have no 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 4). In South Africa, the rationale for not requiring VCU data is based on the fact that market forces should determine the best varieties. If a farmer buys a variety that performs poorly from a given company, the farmer will not return, therefore the company loses that particular customer forever. Lack of published guidelines pose a bottleneck to seed companies as it is not clear which important traits should be presented for variety release.

In Benin, Ethiopia, Nigeria and Uganda, the VCU tests requirements range from two to three seasons whereas Angola requires the data for one season. In Kenya, Ghana, Uganda and Zambia the VCU tests are recorded for five to six 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 which makes it expensive for a seed company to conduct VCU trials in all these locations. If the locations were grouped according to mega-environment then a few but strategic locations could be used to sample the relevant stress. By reducing the number of locations it will be easier and cheaper for seed companies to test their varieties for release. If the mega-environments were to be used for release, then data from other countries with similar mega-environments could be accepted to allow cheaper and faster release of new maize varieties among countries.

In Kenya, Tanzania and Zambia, the NSA is responsible for assembling and conducting national performance trials (NPTs) from which the VCU data is obtained. Once the VCU data have been recorded, the data are then submitted to the NVRC for consideration. The NPT trials do not guarantee that the variety will be released once the trials are complete. In Zambia, the breeder may withdraw his or her variety if he/she feels that it did not perform well in the NPTs in the first year. In Kenya, Tanzania and Zambia the NPTs are conducted by NSA at a given fee. The fees paid for the NPT may hinder some breeders especially those from the public sector from submitting their maize varieties for release, thus delaying the release of a new maize variety. To complement the VCU data from NPT, independent and on-farm trials are required to support the data from NPTs. On-farm trials are used to assess the new maize varieties for farmer preferences.

The mother-baby trials (MBTs) scheme is used in most of the countries to evaluate varieties on farm. The scheme was popularized during the Southern African Drought and Low Soil Fertility Project (Bänziger 1998). This scheme is an innovative farmer-participatory scheme in which a set of experiments are grown in a community by farming communities together with a local partner, such as an extension agent, non-governmental organization (NGO), secondary school or a research station (Figure 1). The MBTs concentrate on the collection of qualitative data. On-farm testing increases the number of years required for variety registration as in most cases, breeders carry out METs first. Once they identify promising varieties, they are promoted to on-farm testing. If on-farm testing could be done at the same time with METs, then the number of years for release of a variety could be reduced. On the other hand, the MBTs have provided a forum for farmers to raise their voice on the choice of the variety they want. This has resulted in fast tracking of varieties for release.

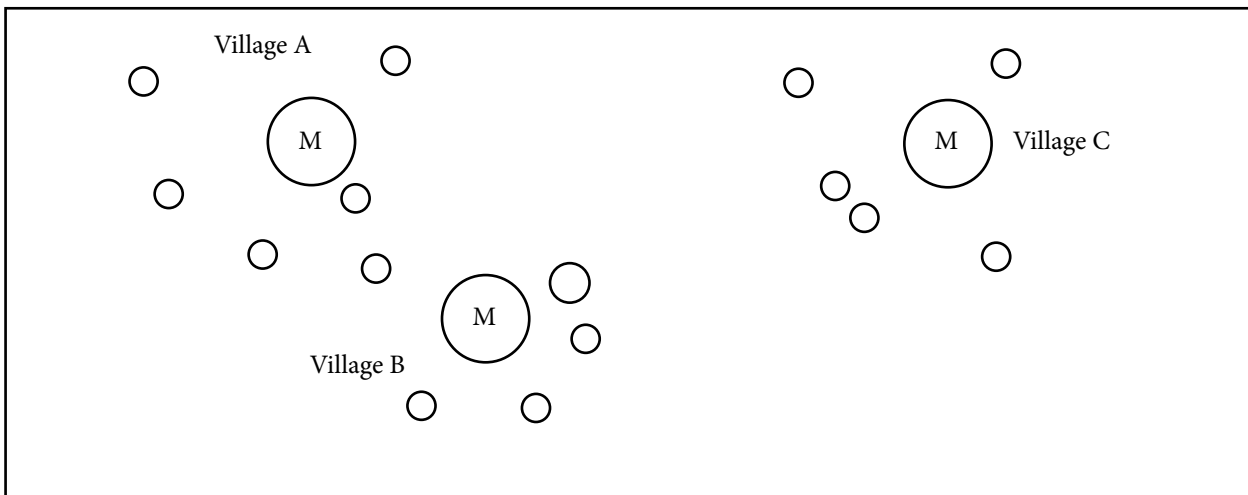


Figure 1. Mother-Baby Trial design to evaluate maize cultivars by researchers and farmers.

Note: “M” indicates a Mother Trial.

The VCU data is recorded on important agronomic traits such as grain yield, disease resistance, plant height and other traits. On average, 10 to 15 agronomic traits are recorded (Table 5). Of the countries surveyed, Ghana records the highest number of agronomic traits at 36 while Zimbabwe and Mali record the lowest number. Recording of agronomic traits is time-consuming and only important ones should be collected.

In Angola, Benin, Mali, Tanzania, Zambia and Zimbabwe, VCU data from other countries with similar agro-ecological zones may be used to complement in-country data. In Kenya, Tanzania and Zambia, a fee is paid for a new maize variety to enter into NPTs. The highest fees for the NPT are paid in Kenya and the lowest in Zambia.

Zimbabwe and Kenya have a stipulated number of varieties that can be registered at one time by a seed company per year. On the other hand, Ethiopia allows only three varieties per agro-ecological zone to be registered by a seed company. Once the VCU data have been collected, a breeder is required to prepare a release proposal which is submitted to the VRC. The limit on the number of maize varieties that a seed company may register per year is one of the major bottlenecks as it limits the number of maize varieties that could 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.

The release proposal consists of an abstract, introduction, breeding history of the variety, VCU and DUS data and the recommended areas for production. In all the countries, the release proposal is submitted only once a year. It is only in Malawi that it can be submitted upon request (Table 5). If a seed company wants to release a variety, it is obliged to wait for another year. In some of the countries, companies are restricted to bulk or multiply seed until the variety is officially released. It takes about two seasons for a seed company to bulk enough seed to enter the market. Bulking of seed usually starts with the production of breeder and foundation seed. Only when breeder and foundation seed is available can certified seed be produced. The process may take even longer for hybrids compared to OPVs, as it takes longer to produce the seed of all the parental inbreds of hybrids.

Once a variety is released, the NARS have to identify a seed company to market the variety. Only Ethiopia, Kenya, Tanzania, Mozambique, South Africa, Zambia and Zimbabwe have PBRs that allow them to charge royalties to any seed company that uses their varieties (Table 3). Royalties provide an incentive to public institutions to market their varieties as opposed to cases where once the variety is released, it sits on the shelf denying farmers access to improved germplasm. Royalties may provide revenue to public research institutes and also offer incentives for promotion of the adoption of released varieties. In most cases, rather than aggressively market the variety, seed companies prefer to have exclusive rights to a variety in order to prevent competitors from having access (Tripp 2001).

Maize varietal releases

Table 6 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 fluctuated between countries. South Africa had the highest average number of varietal release rates at 60 per year followed by Kenya with 16 annually. On the other hand, in some years Ghana, Mozambique, Nigeria and Uganda failed to release a single maize variety. Compared to other countries Kenya, South Africa, Zambia, and Zimbabwe have been more regular in the variety releases per year. The high varietal release rates show the advanced development of the seed industry compared to other countries which failed to release a single maize variety in several years.

Benin has no seed companies and varietal release rates have been very low per year. The varietal release rates were the highest in southern Africa—including South Africa—explaining why the maize area planted to improved maize is the highest across the three regions (Hassan et al. 2001). Besides southern Africa having the highest varietal release rates, it also had the highest adoption rate (52 %) compared to West Africa (4%) (Table1). This indicates that the more improved maize varieties are released, the greater the chances of increased adoption. Where there are high adoption rates of improved varieties, seed companies, extensionists and NGOs promote them (Tripp 2000). Adoption of new varieties also depends on farmers recognizing one or more characteristics that justify its inclusion into their portfolio of varieties or its displacement of another.

Although a number of maize varieties have been released in several countries the time taken to release them has been rather extended. South Africa had the shortest time for variety release and Kenya the longest (Table 7). In Kenya, more time is taken because the variety has to be tested by the breeder first in METs and only when the breeder is satisfied with the performance of the variety that it can be put into 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 build enough quantities of foundation seed for certified seed production. In Malawi, an increase in breeder or foundation seed is not allowed before a variety is registered.

Table 5. Current status of value for cultivation and use in DTMA Project countries and 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	Sept	No	Yes
Uganda	No	Yes	5	3	Yes	Not specified	\$150	Yes	No limit	April and Sept	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

Source: DTMA National variety testing and release survey 2007/2008

Table 6. Average number of varieties released per year 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

Source: DTMA National variety testing and release survey 2007/2008

Table 7. 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

Maize varieties release by region

Southern Africa had the highest number of maize varietal releases per year, followed by eastern Africa and lastly, West Africa (Figure 2). The high rate of varietal releases in southern Africa was mainly attributed to the high rate of release in Zambia. The rate of maize varietal release per year ranged from a single maize variety release in western Africa to 31 in southern Africa. Varietal release rates were the highest in 2004 in southern Africa and the lowest in West Africa across the years. The maize varietal release rates peaked from 2002 to 2005 and dropped sharply in 2006 in eastern Africa while in West Africa the varietal release rates remained stagnant from 2004 to 2006. The peak in varietal release rates in eastern Africa from 2002 to 2005 may be explained by the large number of seed companies that were established in the region during this period compared to West Africa which had very few new seed companies established (Langyintuo et al. 2008).

In eastern Africa, the varietal release rates decreased from 2004 to 2005 and slowly increased again after 2005 (Figure 2). The fluctuations in varietal release rates may be attributed to the fact that after a year of variety releases, seed companies and public institutions shifted their focus from variety release to seed production and marketing. The other reason is that varietal release rates are unpredictable due to the nature of plant breeding—this is often non-existent in small countries with very few seed companies and those that lack breeding programs.

Taking into account the land area planted to maize in eastern, southern and West Africa, there have been more maize variety releases in southern Africa per land area compared to the other regions. This could be attributed to more variability in maize mega-environments compared to eastern and West Africa and also to the large number of seed companies in southern Africa (Setimela et al. 2005; Langyintuo et al. 2008).

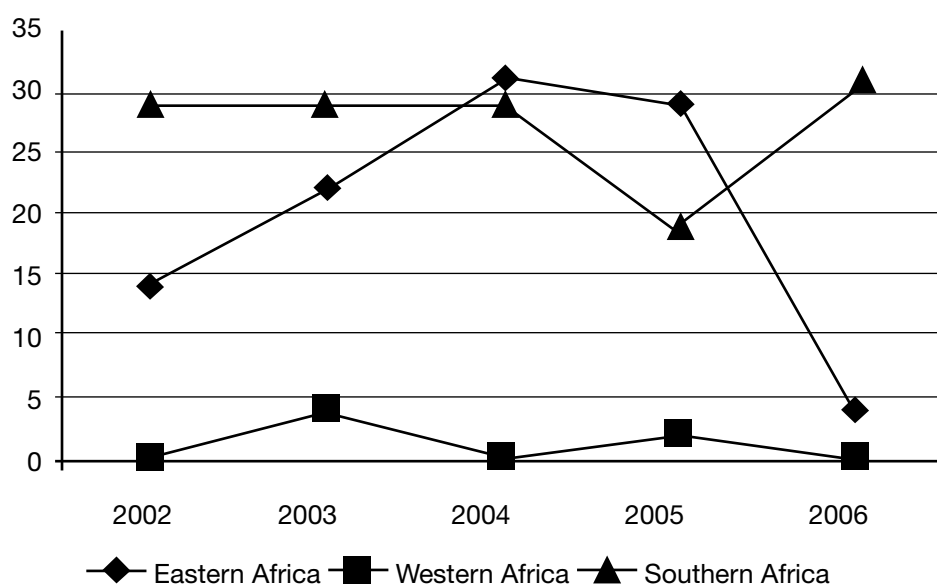


Figure 2. The average maize varietals releases by region 2002–2006.

Source: DTMA National variety testing and release survey 2007/2008

Public and private sector releases

Summary information on maize varieties released by the public and private sector, during the period 2002 to 2006 is shown in Figure 3. The public sector in Angola, Mozambique, Ethiopia, Benin, and Nigeria dominated the maize varietal releases during the period although the number of maize varieties released was very low. On the other hand, in Kenya, Malawi, South Africa, Zambia and Zimbabwe, the private seed sector dominated the maize varietal releases. In southern Africa, excluding South Africa, the private seed sector in Zambia and Zimbabwe had the highest varietal release rates reflecting not only the large area planted to maize but also the large number of public and private breeding programs (Langyintuo et al. 2008; Figure 2). These countries are signatories to the UPOV convention and hence have PBRs which offer incentives for private seed companies to increase their investment in maize breeding programs. This establishes legal ownership of new maize varieties.

The high number of varietal releases by the private seed sector in southern and eastern Africa shows that maize breeding programs are concentrated within the private sector unlike in West Africa where the breeding programs are mostly concentrated in the public breeding programs. The number of maize varieties released by the private sector also shows the volume of investment this sector has made towards maize breeding. Scientists working in the private sector are strongly supported by well-established testing, production, and marketing systems whose goal is to increase and maximize profits. On the other hand, in the public sector there is no pressure to increase profits.

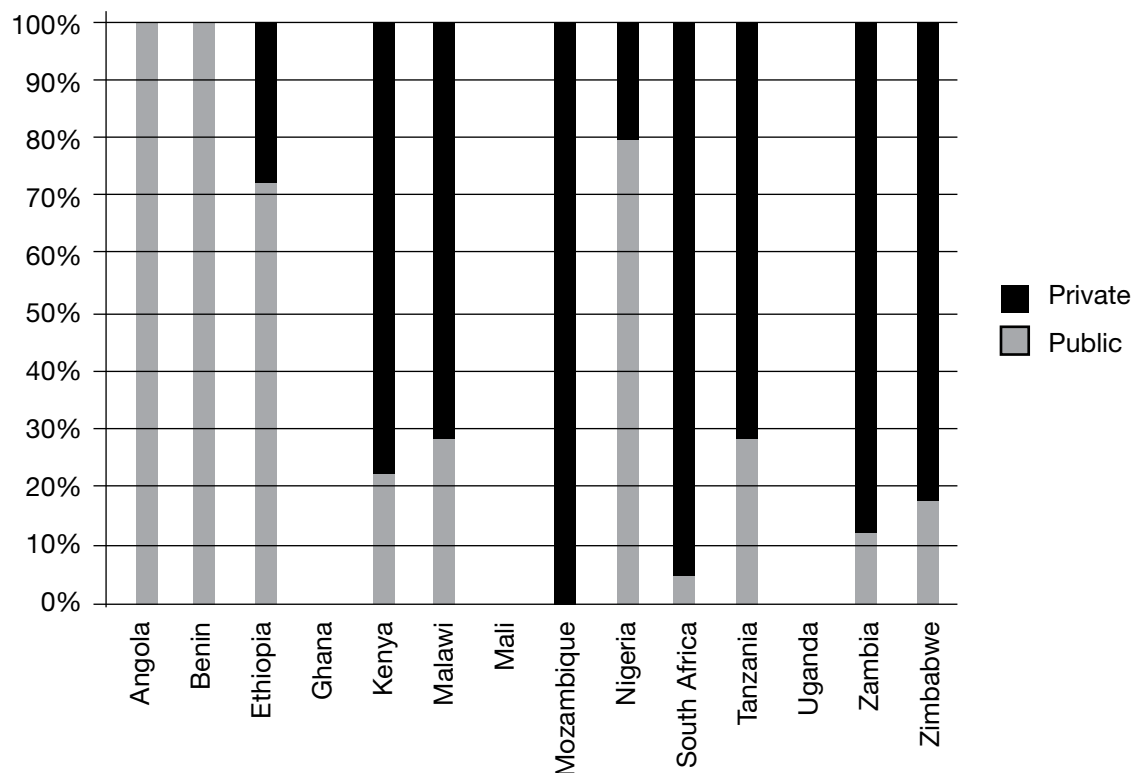


Figure 3. Percentage of public and private seed sector maize releases in DTMA Project countries including South Africa, 2002–2006.

Source: DTMA National variety testing and release survey 2007/2008

Type of germplasm released in DTMA project countries in SSA

Table 6 shows the number of maize varieties released in the 13 DTMA project countries in SSA disaggregated by type of material (OPVs vs. hybrids). White hybrids dominated the number of maize varieties releases, followed by white OPVs. Most seed companies focus mainly on hybrid seed. By region, countries in southern Africa have concentrated mainly on hybrid maize releases. Across the regions, hybrids have constituted more than 60% of the maize releases. With hybrids, farmers have to buy fresh seed every year while with OPVs, farmers can recycle the seed for few seasons before having to buy fresh seed. Most of the OPVs have been released by public institutions and small emerging seed companies targeting smallholder farmers. Small emerging seed companies prefer to embark on the production of OPVs due to the simplicity in seed production compared to hybrids. In southern Africa, seed companies place more emphasis on hybrids.

Regarding yellow and white maize, South Africa is the only country that had an equal number of white and yellow maize releases. In eastern and southern Africa, white maize is mostly preferred for preparing the staple foods. In South Africa, yellow maize is mostly used for animal feed which explains the high number of yellow maize releases. Apart from South Africa, Angola and Zambia have a number of yellow maize variety releases. In Angola, white and yellow maize varieties are preferred equally for making staple dishes.

Table 8. Estimated number of maize varieties by type released by public and private breeding programs in DTMA Project countries including South Africa, 2002–2006.

Country	OPVs		Hybrids		Total
	White	Yellow	White	Yellow	
Angola	9	2	14	6	31
Benin	6		1		7
Ethiopia	6	0	12	0	18
Ghana	0	0	0	0	0
Kenya	6	0	49	0	55
Malawi	0	0	7	0	7
Mali	0	0	0	0	0
Mozambique	4	0	0	0	4
Nigeria	3	1	2	0	6
South Africa	19	6	134	154	313
Tanzania	1	0	6	0	7
Zambia	5	0	40	6	51
Uganda	0	0	0	0	0
Zimbabwe	5	0	13	1	19
Total	58	9	277	167	518

Source: DTMA National variety testing and release survey 2007/2008

Summary: organization and structure of variety release system by countries

Angola

The Instituto de Investigação Agronómica de Angola (IIAA) has a breeding program for maize and other crops. The institute conducts multi-locational trials and once a variety is found to have a good agronomic performance, it is promoted to on-farm trials to get feedback on farmers' preferences. When the on-station and on-farm testing is complete, the data are submitted to the Scientific Council for scrutiny and final decision on whether the variety should be released. At least one season of testing is required for a new maize variety before it is considered for release. The NVRC is made up of Crop Research, National Seed Services and Genetic Resources personnel and the Deputy Minister of Agriculture. There are no representatives from seed companies on the variety release committee as in other countries. A number of new varieties from Brazil along with varieties from seed companies normally enter the country's market without being subject to DUS and VCU testing (Figure 4). Procedures for a variety release system are being developed.

Angola has performed poorly in variety releases (Table 5). This may be due to the fact that there are no seed companies in the country and most of the seed is sold by companies operating from outside the country. The guidelines for collection of data for DUS and VCU are not very clear and this makes it difficult for seed companies to release new maize varieties.

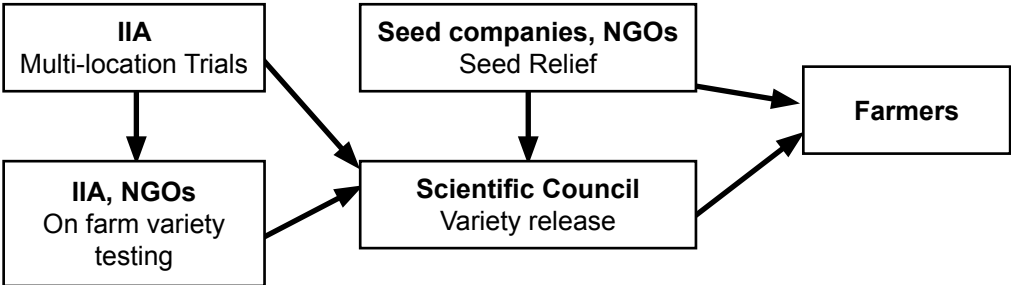


Figure 4. Variety release channel in Angola.

The variety release system is very slow in Angola since there are no guidelines on how new maize varieties should be released. The bulk of the seed is imported from South Africa and the neighboring countries.

Benin

Maize improvement in Benin is the responsibility of the Institut National des Recherches Agricoles du Benin (INRAB). INRAB develops maize varieties and conducts the national multi-location variety trials in all maize growing ecologies of the country. The institute also conducts extensive on-farm trials throughout the country in collaboration with the extension services of the Ministry of Agriculture and Rural Development. Even though Benin does not yet have a defined seed law and no formal varietal release mechanism is presently operational in the country, the national scientists of INRAB conduct several on-station and on-farm trials annually. However, there is no functional NVRC. Several varieties have been informally released and are in the hands of Beninois farmers.

Ethiopia

The Ethiopian Institute of Agricultural Research (EIAR) has a national breeding program which develops and conducts variety evaluation. An average of 50 on-station maize trials are conducted annually. Before new varieties can be registered, they must be evaluated in the regional or national trials for three seasons across three to five locations. The new varieties must be distinct and agronomically superior to the check by more than one characteristic. The DUS data should have a complete morphological description of the candidate variety. Once the DUS and the VCU data have been recorded, it is then submitted to the NVRC which is organized by the National Seed Industry Agency under the Ministry of Agriculture (MoA). The NVRC is composed of a breeder, a food scientist, an extensionist, an entomologist, a pathologist, an economist and a representative from one of the crop improvement institutions. The NVRC is responsible for scrutinizing and approving the release of new varieties based on the data submitted (Figure 5). The NVRC is assisted by a technical committee that evaluates trial data, undertakes field inspections, and makes recommendations to the NVRC, who are responsible for the final decision on whether to release a variety. Maize varietal release rates in Ethiopia have been improving compared to other countries in the same region.

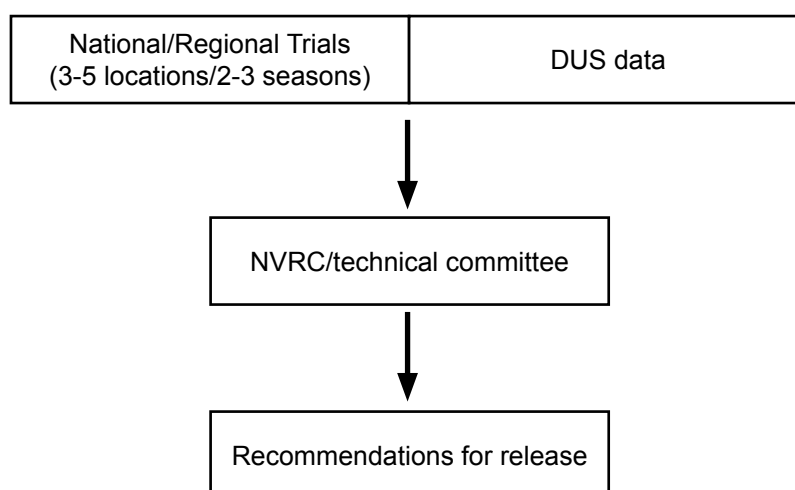


Figure 5. Variety release channel in Ethiopia.

About 18 varieties have been released in Ethiopia over the past five years (Table 6). The release process is slow as it allows only three varieties per ecology to be submitted for release by a given seed company. If a seed company wants to release more than three varieties per ecology, it has to wait for the following season.

Ghana

The Crops Research Institute (CRI) and the Savanna Agricultural Research Institute (SARI) of the Council for Scientific and Industrial Research (CSIR) are responsible for the development and on-station evaluation of maize varieties and hybrids in Ghana (Figure 6). The two institutes have several experiment stations scattered throughout Ghana for extensive multi-location trials. At least two years on-station data, two years on-farm data, consumer preference data, physico-chemical and economic analysis are required for the release of a variety. The on-farm trials are conducted by the researchers of CRI and SARI in collaboration with the extension staff of the Ministry of Food and Agriculture (MOFA). The consumer preference data are collected by the women staff of MOFA while the physico-chemical analyses are conducted by the Departments of Food Science at the University of Ghana, and Food Science Research Institute of CSIR. The economic analyses are carried out by the economists at CRI and SARI.

Once all the required data for the release of a variety have been assembled, an application for the release of the variety is submitted to the NVRC which is composed of the Directors of CRI, SARI, Department of Agricultural Extension Services, Women in Agricultural Development, Crops Services Division, Grains and Legumes Development Board, Plant Protection Regulatory Services Division, the representative of the Universities of Ghana, a plant breeder, a representative of the Seed Growers' Association, a seed technologist, Head of the Ghana Seed Inspection Division, Head of the National Seed Service, a representative of the seed dealers' association and a farmers' representative.

The members of the NVRC visit the breeder seed field twice during the growing season. The first visit is at the flowering stage and the second is at harvesting. Based on these visits, the committee decides whether or not the process for the release of the variety should go on. If the committee is happy with the performance of the variety in the breeder seed plot, a date is fixed for a committee meeting to consider the release of the variety. The sponsoring breeder of the candidate variety is responsible for the presentation of the necessary data during the meeting of the NVRC to support the release of the variety.

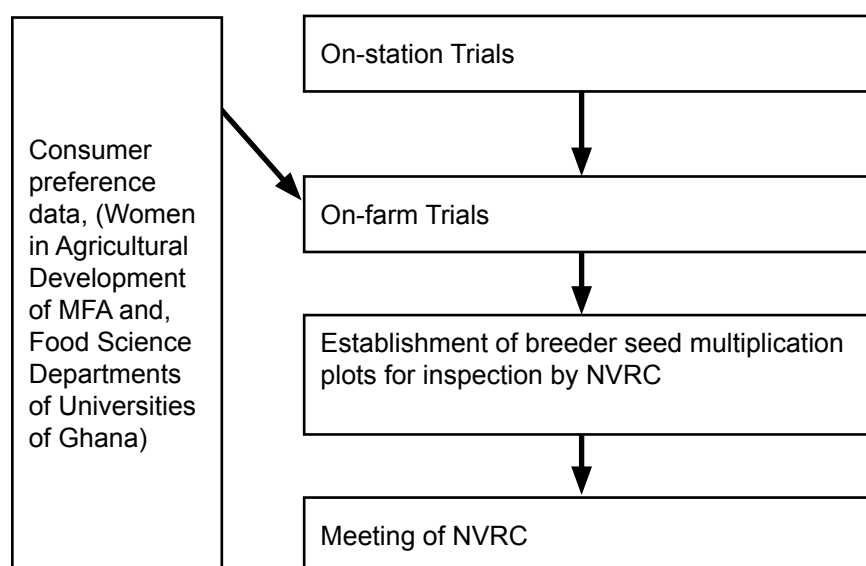


Figure 6. Variety release channel in Ghana.

The rate of release of new maize varieties has been poor. In the past five years, no maize varieties have been released (Table 5). Poor rate of variety release may be due to the few seed companies operating in the country. Ghana is the only country that requires an economic analysis before the release of a new maize variety.

Kenya

Kenya's national maize breeding program is responsible for developing and evaluating new maize varieties. In addition to the national breeding program, a number of seed companies also evaluate and conduct variety trials in various ecologies. When superior varieties with good agronomic traits have been identified from multi-environmental trials (METs), they are included in the national performance trials (NPTs) for further evaluation by the Kenya Plant Health Inspectorate Service (KEPHIS). KEPHIS will then carry out its own independent VCU and DUS tests of the candidate variety.

Table 9 shows that of the number of maize varieties submitted to KEPHIS for testing from 2000 to 2006, only about 10% were approved for release. The DUS and VCU tests are carried out for a minimum of two seasons according to UPOV protocols. Besides VCU and DUS data, on-farm data must also be submitted by the breeder. After completion of the DUS and VCU tests by KEPHIS, the data are submitted to the National Performance Trials Committee (NPTC) for assessment. KEPHIS chairs the NPTC meetings comprising various stakeholders from the seed sector. At the end of the meeting, the NPTC makes its recommendation as to whether or not the variety should be approved for full release, pre-release or rejected. The recommendations from NPTC are forwarded to the NVRC for endorsement and final recommendation and approval by the MoA. The released varieties are then announced by the Minister of Agriculture before being entered into the national variety catalogue.

In eastern Africa, Kenya leads in the number of maize variety releases. This is a reflection of the number of seed companies presently operating in the country.

Figure 7 shows the variety release channel in Kenya from METs to variety release. There are delays between variety identification and release. Once the variety has been identified by the breeder it tested again on the NPTs for two seasons. The breeders may not have the funds to put their candidate variety into NPTs as there are fees to be paid. The variety has to be released before seed multiplication and marketing can start.

Table 9. The number of varieties tested and released by the KEPHIS.

Year	Number of varieties tested	Number of released varieties
2000	95	0
2001	153	14
2002	154	10
2003	140	22
2004	117	25
2005	114	21
2006	155	4
Total	928	96

Source: DTMA National variety testing and release survey 2007/2008

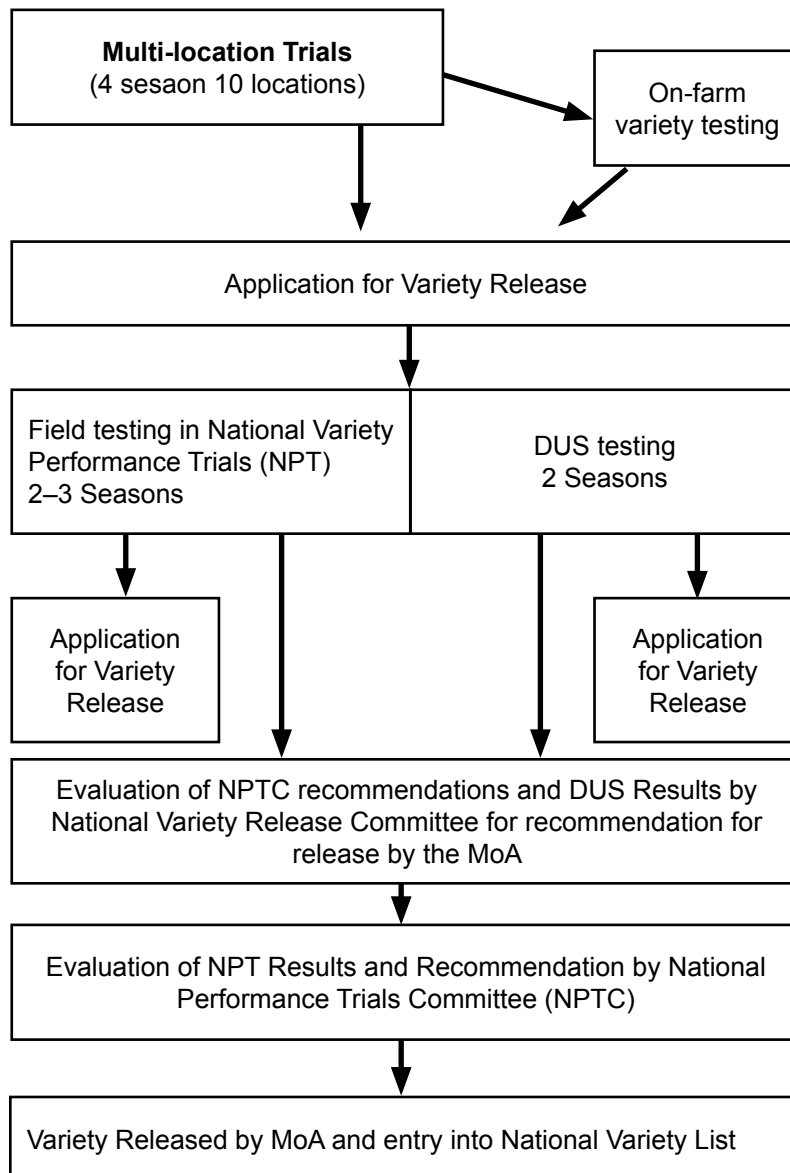


Figure 7. Variety release channel in Kenya.

Malawi

The Department of Agricultural Research (DAR) and seed companies annually evaluate maize varieties. Once the varieties have been evaluated, the Agricultural Technology Clearing Committee (ATCC) is responsible for approving maize varieties for release. The ATCC is composed of the Director of Research and Technical Services, representatives of the Bunda College of Agriculture, Agricultural Research and Extension Trust, the National Research Council and the Permanent Secretary in the Ministry of Agriculture and Food Security. A minimum of two to three years of VCU data are required, accompanied by on-farm trials data before a new variety can be approved for release (Figure 8). The data from other countries with similar agro-ecologies may be used to supplement national data for variety release. Unlike in other countries, the DUS is not a requirement but a breeder must present morphological traits which will be used by the seed inspectors for the purpose of seed inspection.

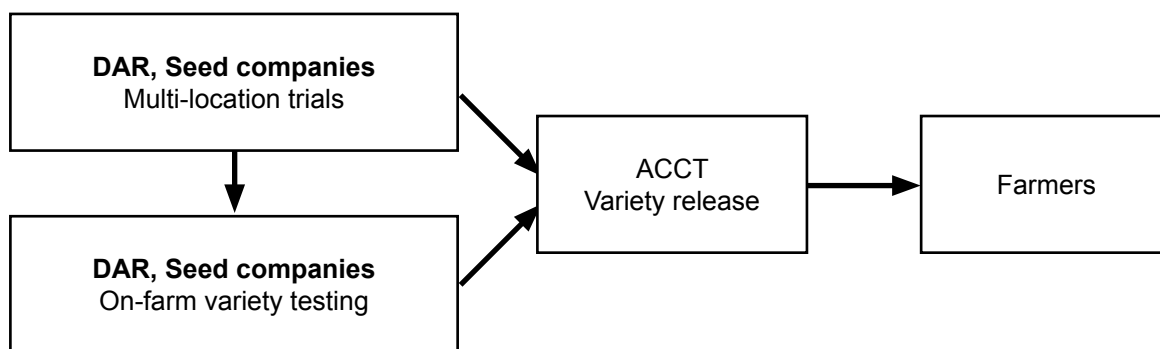


Figure 8. Variety release channel in Malawi.

The rate of variety release in Malawi has been steady due to the number of seed companies that are now operating in the country (Table 6). A number of OPVs and hybrids have been released. On-farm variety testing can delay the release of a variety as transport and funding are not always available to support on-farm testing.

Mali

The Institut d’Economie Rurale du Mali (IER) has the mandate for breeding and evaluation of maize varieties in Mali. The institute carries out the national variety trials at multi-locations in the Guinea and Sudan savanna ecologies of the country (Figure 9). In addition, IER carries out on-farm trials and demonstrations in collaboration with the national extension systems, private seed companies and NGOs such as Sasakawa Global 2000. The seed law has not yet been disseminated. Therefore, there is no formal variety release mechanism and varieties are informally released to farmers through on-farm trials and demonstrations. Several improved varieties have been released informally by IER and are presently in the farmers’ hands.

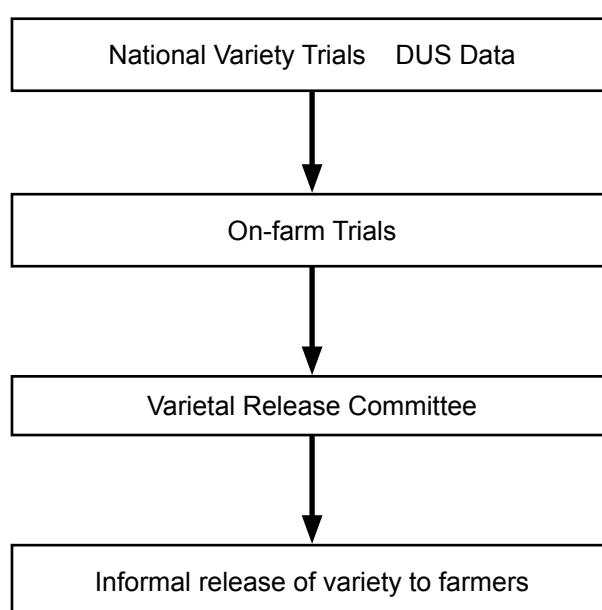


Figure 9. Variety release channel in Mali.

Mozambique

The Instituto de Investigação Agrária de Moçambique (IIAM) is responsible for improving and conducting maize variety trials in the country. The trials, conducted by the institute, provide data for variety release although independent institutions may also submit their own data from variety trials for variety release. The DUS and VCU are carried out for a minimum of two seasons. The DUS tests may be carried out for one season if the breeder can provide the description of the candidate variety to supplement the DUS tests (Figure 10). The Department of Seed Service (DSS) must verify the data from the independent institutions before it is presented to the Variety Release Committee. The Variety Release Committee is composed of the National Director of Agriculture as the President, and representatives from IIAM, extension, research, farmers' associations, seed growers' associations, seed companies, MoA policy and planning and the national seed services.

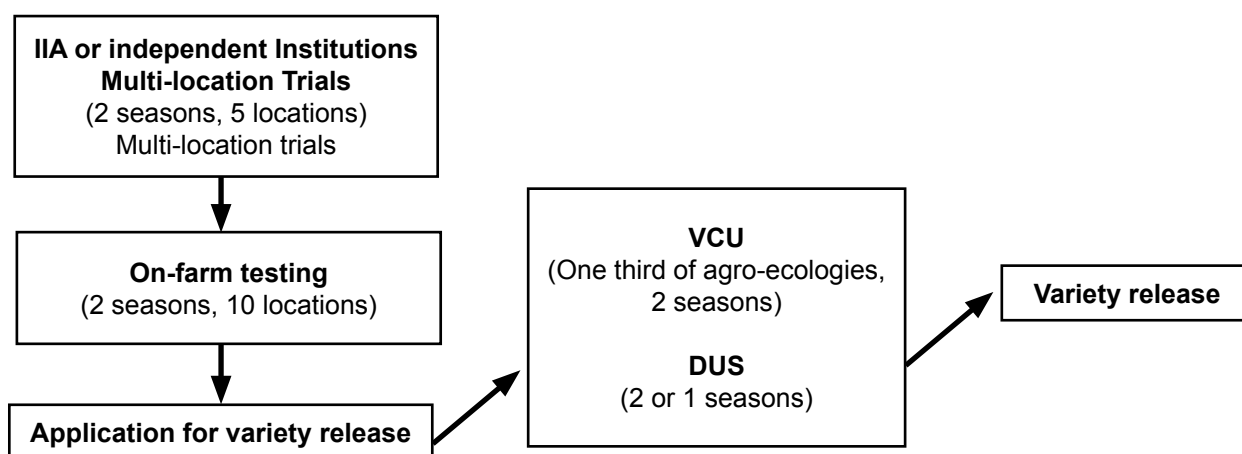


Figure 10. Variety release channel in Mozambique.

Performance has been poor in terms of variety releases during the past five years (Table 6). Only six varieties were released. The poor performance may be attributed to the very few seed companies in the country.

Nigeria

The Institute for Agricultural Research (IAR) of the Ahmadu Bello University, Samaru and the Institute for Agricultural Research and Training (IAR&T), Moore Plantation have the mandate for maize research in Nigeria. In addition to the two institutions, the University of Maiduguri, the University of Ilorin and seed companies such as the Premier Seed Company are also involved in maize research and development. The nationally coordinated trial is conducted throughout the country annually and is a major vehicle for testing maize varieties in multi-location trials and identifying promising ones for release in Nigeria (Figure 11). In addition to the nationally coordinated trial, varieties for release are tested on-farm for at least two years before release. Apart from the yield and agronomic data required for varietal release, consumer preference data and physico-chemical analysis data are also required for the release of varieties. A maize breeder in a public research institute or a private seed company has to go through a number of

steps to get a new variety released and registered by the National Crop Varieties and Livestock Breeds Registration and Release Committee (NCVLBRRC). The maize breeder, with the approval of the research institute, submits the variety to the relevant Nationally Coordinated Research Project (NCRP) for nationwide multi-location on-station trials managed by researchers in the appropriate agro-ecologies. After the first year of the NCRP on-station multi-location trials, if the variety significantly out-yields the commercial variety used as a check, the variety is submitted to the appropriate national crop center for multi-location on-farm trials. These trials may run concurrently with the second year of NCRP on-station trials to confirm the results of the first year trials. In case there is an urgent need for the release of a variety, the first year NCRP multi-location trials may run concurrently with the on-farm testing of the variety slated for release. If the performance of the variety in the two years of NCRP on-station and one year on-farm multi-location trials is outstanding for the relevant traits, including yield and farmers' preference, the institution of the breeder in consultation with the National Coordinator of the NCRP of the crop may apply to the Registrar of NCVLBRRC for consideration of the release and registration of the new variety. The breeder then completes the relevant general and specific descriptors format of the variety and submits it with comprehensive data from NCRP on-station and crop center and/or on-farm trials to the Registrar not later than two weeks before the meeting of the Technical Sub-Committee (TSC) Crops and the NCVLBRRC meeting scheduled to consider the application for the release and registration of the variety. The breeder of the variety under consideration for release must bring a prescribed quantity of seed of the variety for the national gene bank and also make provision for sufficient breeder seed for the National Agricultural Seed Council, for the purposes of foundation seed production.

The NCVLBRRC comprises:

- the chairman who is appointed by the President of Nigeria,
- the Director of Agricultural Sciences, Federal Ministry of Science and Technology,
- the Director, Federal Department of Agriculture and Rural Development,
- the Head of the Genetic Resources Unit, Federal Ministry of Science and Technology,
- the Director, National Seed Services,
- the Chairman, Committee of Deans of the Faculties of Agriculture in Nigerian Universities,
- the President, Genetic Society of Nigeria,
- a representative of the Federal Agricultural Coordinating Unit,
- two experienced breeders appointed on their personal merit by the Minister, and
- two General Managers representing two River Basin Development Authorities from different ecological areas in rotation appointed by the Minister.

The committee is expected to meet annually but due to fund limitations, the meetings are irregular. Following the release of a variety, it is entered into the National Variety Release Catalogue. The rate of release of new maize varieties has been poor. The last maize variety was released in 2005. In the past five years only six varieties have been released (Table 6). The NVRC has not met regularly, thus contributing to a poor rate of release. Only a few seed companies operate in Nigeria, therefore, there has been little pressure to release new maize varieties.

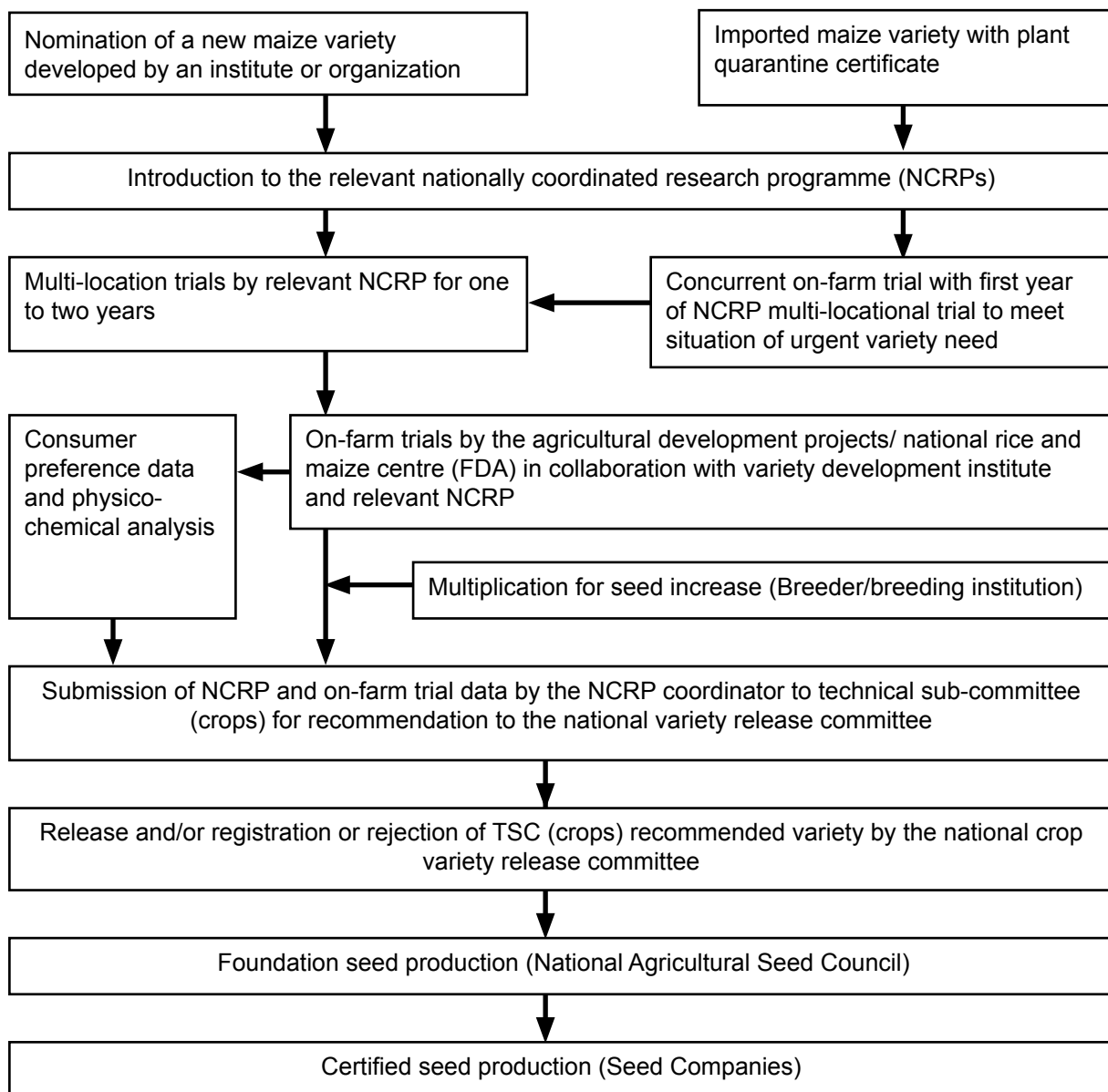


Figure 11. Variety release channel in Nigeria.

Tanzania

In Tanzania, maize breeding is carried out by the various agricultural research institutes under the MoA. For new varieties to be released, they need to be tested by the breeder for VCU for a minimum of three seasons. Once testing is complete, the grain is submitted to the Tanzania Official Seed Certification Institute (TOSCI) for VCU and DUS tests for a minimum of one season. The VCU and DUS tests are conducted by TOSCI in selected areas depending on the recommended areas for the variety. Once the tests are complete, the Variety Release and Seed Certification Committee evaluate the data in order to make recommendations for release (Figure 12). The release committee is composed of the breeder of the variety, a pathologist, an entomologist, an economist, Director of Crop Development as Chairperson, Assistant Deputy Director of Research, and one member from the Seed Inspection Unit and TOSCI who also presents the DUS certificate. The rate of variety release has been acceptable, given that there are only a few seed companies in the country (Table 6). Unlike in Kenya, the NPT trials are conducted for a single season, which may hasten the rate of release.

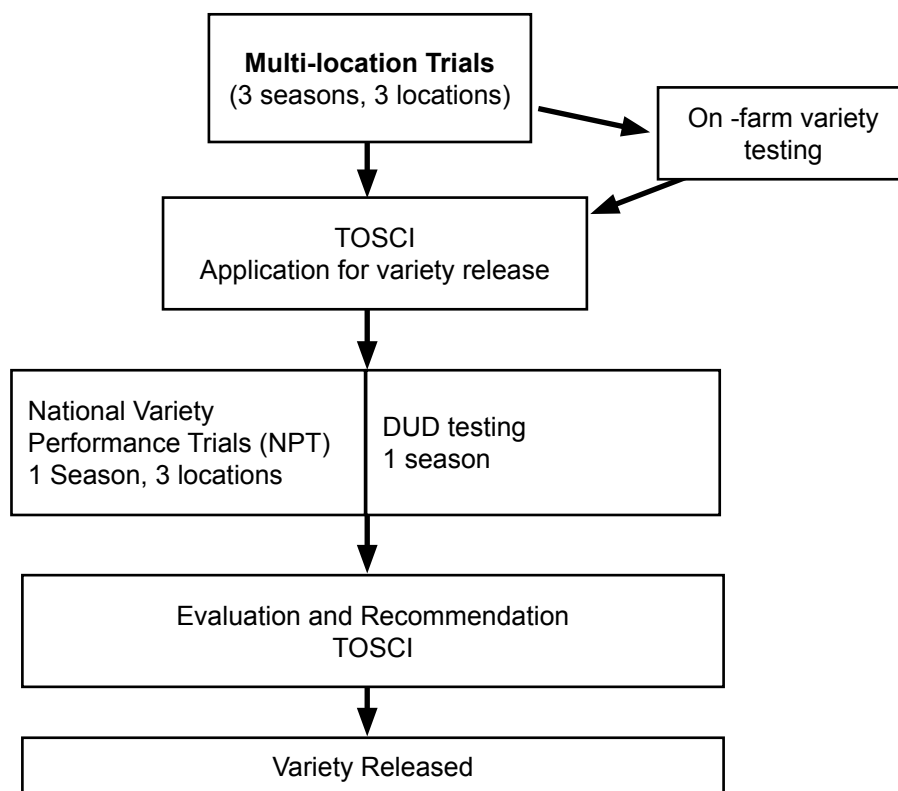


Figure 12. Variety release channel in Tanzania.

Uganda

Uganda has a maize breeding program. For new maize varieties to be released and marketed in the country they must pass the DUS and VCU tests. The DUS tests are conducted by the National Seed Certification Service Unit of the Ministry of Agriculture. The DUS data must be collected for a minimum of two seasons across two locations. The NARS breeder is responsible for collecting the VCU data for a minimum of three seasons across five locations. The charges for collecting VCU data are US\$150 per variety while those for DUS data are US\$200 per variety. Once the data are ready, the breeder prepares a variety release proposal. The variety release proposal comprises the following:

- introduction,
- pedigree of the variety,
- description of the variety,
- site description,
- results and discussion,
- agronomic package, and
- variety maintenance.

Once the release proposal is ready, it is presented to the NVRC which is composed of three breeders (grain, forestry, and propagated crops), an agronomist, a biotechnologist, a representative of the private sector, three seed inspectors, DG National Agricultural Research Organization (NARO), and Director of Research NARO. The NVRC is appointed by the Commissioner of Crop Protection guided by the Seed Act. The variety release channel for Uganda is shown in Figure 13.

The rate of variety release has been poor in Uganda (Table 6).

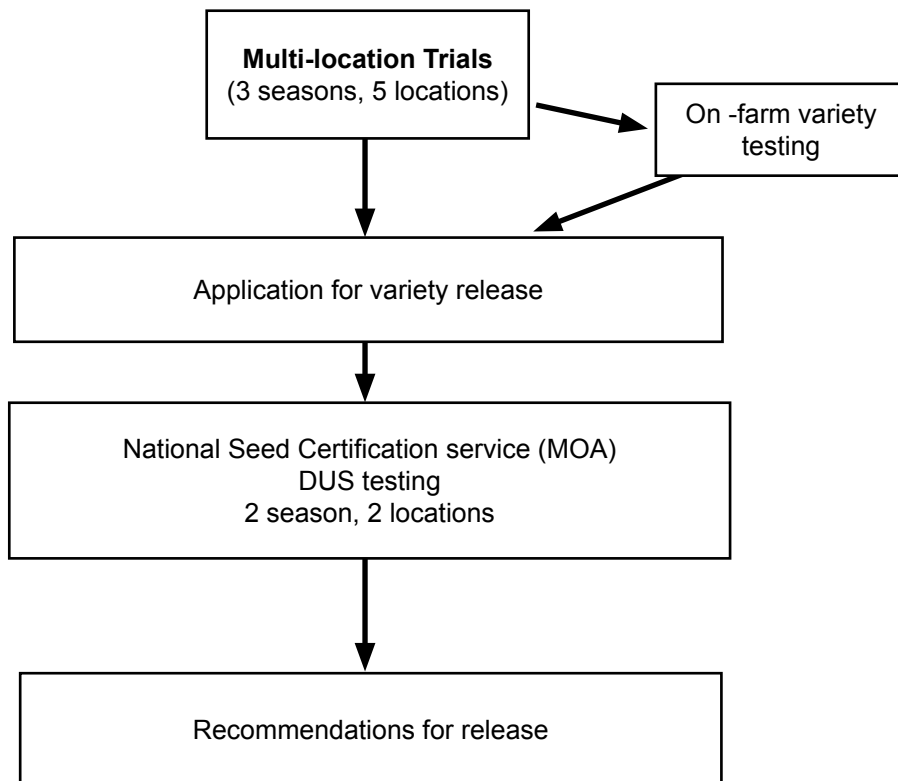


Figure 13. Variety release channel in Uganda.

South Africa

South Africa requires that for new maize varieties to be marketed, they must pass the DUS test before entry into the national variety list. The DUS tests focus on the new and distinctive aspects of the variety. One season's data for DUS is enough to meet the release requirements and for the variety to be entered into the national variety catalogue and thus be granted registration and PBRs. Unlike in other countries there is no NVRC, The department of Agriculture is responsible for conducting DUS. The test of stability continues once the variety has been released as seed inspectors continue to monitor seed production plots. The Agricultural Research Council (ARC) coordinates the National Variety Performance Trials (NVPT), where seed companies may enter their varieties to be evaluated for agronomic performance. These NVPTs are not a requirement but give the seed companies an opportunity to evaluate their varieties for yield performance against other varieties from other seed companies. More than 60 to 80 maize varieties are released every year. With the high number of variety releases it becomes difficult to conduct DUS. The high rate of variety release is accounted for by the high number of seed companies in the country and the liberal varietal release system.

Zambia

In Zambia there are a number of institutes and seed companies which have active breeding programs. For new varieties to be registered and listed in the national catalogue they need to pass DUS and VCU tests. The DUS and VCU tests are conducted by the Seed Control and Certification Institute (SCCI) which is responsible for all variety release procedures in the country. The variety release procedures are managed by a Variety Release Committee with the SCCI as the Secretariat. The composition of the release committee includes representatives of farmers' associations, Zambia Seed Trade Association, University of Zambia Faculty of Agriculture, Extension, and Farming systems research, a specialist in plant protection, a breeder, a seed specialist, and seed certification agency as secretariat. The DUS and NPTs are conducted for a minimum of one or two seasons, respectively by SCCI. The breeder is expected to provide information about the variety to support data from NPTs (Figure 14). After the stipulated number of years of testing, the variety owner applies for release and is expected to present data related to VCU and DUS which are verified by independent data from the SCCI.

There has been regular release of improved varieties of maize over the past five years (Table 6). This is attributed to the large number of seed companies which have breeding programs in the country. The variety release process can be slow because once a new variety has been identified from METs it has to be tested again in the NPT for two consecutive seasons in similar environmental conditions. The procedure allows "pre-release" in some cases with limited seed production and marketing while the variety is still in NPTs.

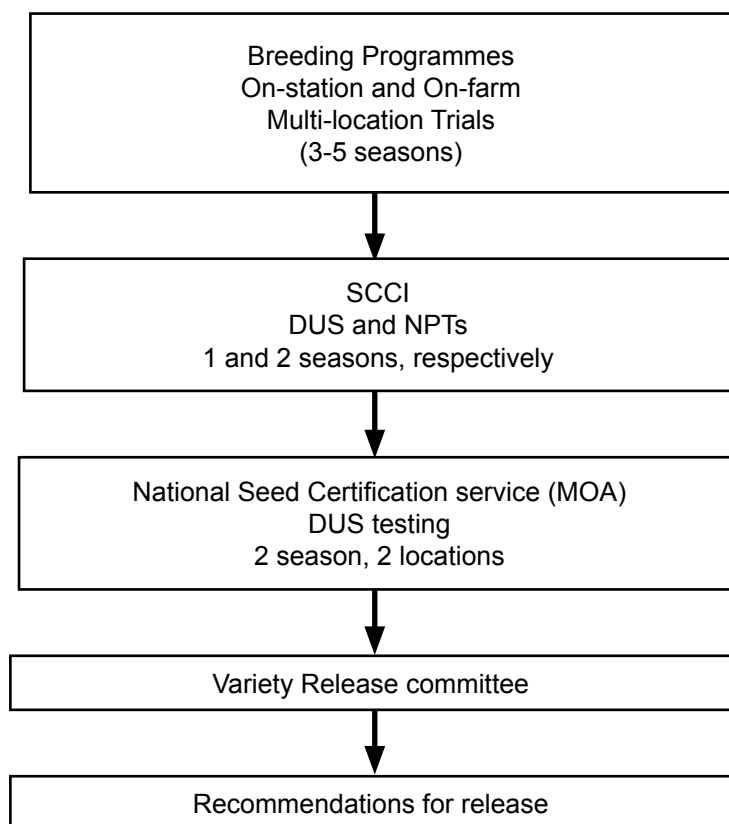


Figure 14. Variety release channel in Zambia.

Zimbabwe

In Zimbabwe, the Agricultural Research and Extension (AREX) under the Ministry of Agriculture has a maize breeding program. Beside AREX, several seed companies have maize breeding programs. Each year a number of on-station and on-farm trials are conducted by AREX and seed companies. The certifying authority (Seed Services) requires that for new varieties to be released they must pass DUS and VCU tests. Seed Services only carry out DUS tests while the VCU tests are carried out by the maize breeder. The VCU trials should be conducted in Zimbabwe for a minimum of two seasons (Figure 14). Once the data are complete, they are presented by the breeder before the release committee which is appointed by the Minister of Agriculture. The Committee comprises representatives from Seed Services, Farmers' Union, Grain Marketing Board, Crop Breeding Institute, processors, millers, merchants, extensionists and researchers. Once the variety is released, seed multiplication can begin under the certification scheme. The procedure for eligibility or recognition involves completion of an application form, which requires the applicant to give details on the origin of the variety, breeding history, procedure of maintenance of stock and performance data. Once the variety is released it is entered into the national variety catalogue and given PBRs.

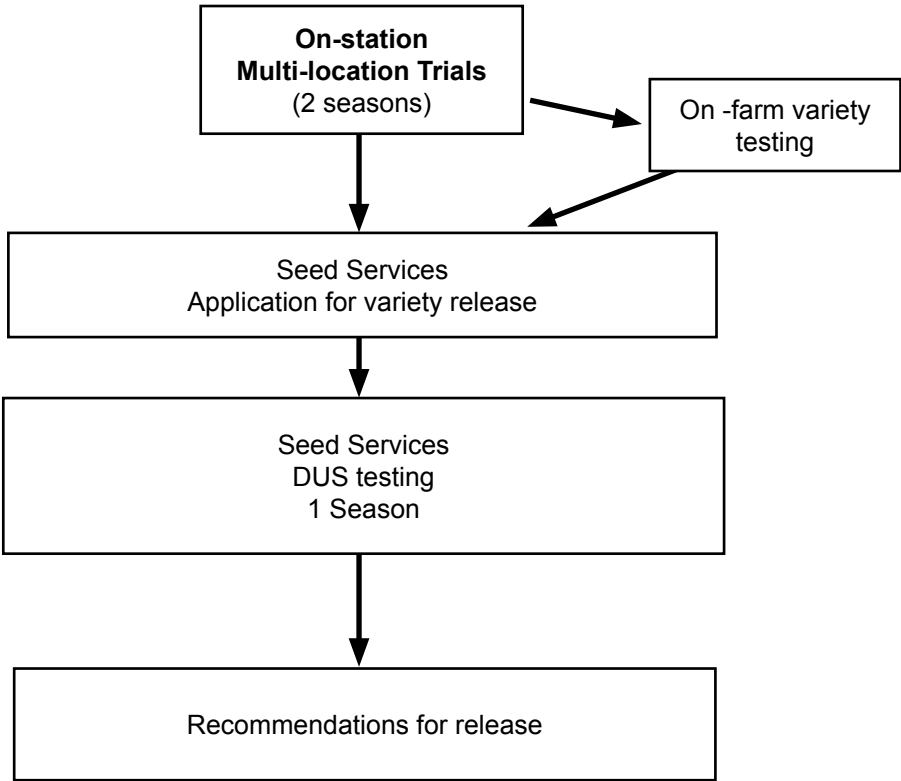


Figure 15. Variety release channel in Zimbabwe.

In terms of variety release, only 22 new maize varieties have been released in the past five years. The few variety releases may be attributed to the relocation of some of the seed companies out of the country due to the political situation. Unlike in Zambia and Kenya, the breeders in Zimbabwe can use their own seed for variety release. There is no need for national performance trials.

Conclusions and recommendations

The conclusions that emerged from this study are 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 national seed authorities (NSA) determine if the new maize varieties are DUS and meet the criteria for VCU in the respective countries. Lack of an effective variety release system is one of the major impediments in the transfer of available elite maize varieties to smallholder farmers in DTMA Project countries in SSA. The long delay between variety development, registration and the release constitutes a major constraint to increased maize production and productivity. Lack of a functional variety release system has contributed to a delay in varietal releases. Most of the VRCs lack good coordination and meet only once a year to consider varieties for release. The seed laws are very rigid as the use of data from other countries with similar agro-ecology cannot be used. This creates a delay, because re-testing has to be done each time a new variety is released.

National variety lists are not updated regularly, making it difficult for seed companies to commercialise improved varieties. Only a few countries have PBRs and the lack of PBRs discourages many private seed companies from introducing their best products, since their products are not protected. White hybrids dominated the number of maize varieties released, followed by white OPVs. In southern Africa, the greatest focus has mainly been on hybrid maize releases and hybrids constitute more than 50% of the releases. The private sector has dominated the varietal release rates in eastern and southern Africa while in West Africa the variety release has been mainly from the public sector, reflecting few seed companies compared to the other two regions. Beside southern Africa having the highest varietal release rates, it also has the highest adoption rate of improved maize varieties.

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:

- *Promotion of regional standards for PBRs:* Regional standards for PBR should be promoted to allow plant breeding programs to generate income from the products of their research through royalties. This will allow the private and the public sector to benefit from the product of research and lead to more investments in variety improvement. Therefore the study recommends the development of PBRs in each country.
- *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. Mega-environments 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. Therefore, this study supports regional variety release based on mega-environments.
- *Promoting the use of data from other countries:* Only a few countries accept data from other countries for variety release. Testing should not be mandatory for varieties already released in other countries if the recommendation domain is the same. If data from other countries are accepted for variety release this will eliminate the need for re-testing of varieties from country to country, thus saving resources and quickening variety release.

- *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.
- *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.
- *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.
- *Variety release guidelines:* In some cases the 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.
- *Frequency of the meetings of NVRC:* The variety release meetings have been irregular in some countries. Therefore, this study encourages governments to ensure that the NVRC meets regularly and that funds are made available for the meetings.

References

- Alhassan, W.S. and P. Bissi. 2006. Program for Africa's seed system: country report Ghana. Accra, Ghana: Rockefeller Foundation.
- Bänziger, M., Setimela P.S., D. Hodson, and B. Vivek. 2006. Breeding for improved drought tolerance in maize adapted to southern Africa. *Agricultural Water Management* 80 (2006): 212–224.
- Bänziger, M. 1998. *The Southern African Drought and Low Soil Fertility Project: CIMMYT Annual Report*. Harare: CIMMYT.
- Doswell, C.R., R.L. Paliwal, and R.P. Cantrell. 1996. *Maize in the Third World*. Boulder, Colorado: Westview Press.
- Ewool, F. 2007. Private seed sector in maize production in Ghana. Unpublished company profile.
- FAO (Food and Agriculture Organization of United Nations). 2001. *FAOSTAT*. Rome, Italy.
- FAOSTAT (Food and Agriculture Organization Statistical Database) 2006. <http://faostat.fao.org/faostat/collections?Subset=Agriculture>.
- Hassan, M.R., M. Mekuria, and M. Mwangi. 2001. Maize breeding research in eastern and southern Africa: current status and impacts of past investments made by public and private sectors 1966–97. Mexico, D.F.: CIMMYT.
- Lanteri, S., and L. Quagliotti. 1997. Problems related to seed production in the Africa region. *Euphytica* 96: 173–83.
- Langyintuo, A.S., W. Mwangi, A.O. Diallo, J. MacRobert, J. Dixon, and M. Bänziger. 2008. An analysis of the bottlenecks affecting the production and deployment of maize seed in eastern and southern Africa. Harare, Zimbabwe: CIMMYT.
- Tripp, R. 2000. *Strategies for seed system development in sub-Saharan Africa: a study of Kenya, Malawi, Zambia, and Zimbabwe*. Working Paper Series no. 2. Socioeconomics and Policy Program. Bulawayo, Zimbabwe: International Crops Research Institute for the Semi-Arid Tropics.
- Maredia, M., and J. Howard. 1998. *Facilitating seed sector transformation in Africa: key findings from the literature*. FS II Policy Synthesis No 33. Washington and East Lansing: USAID and Michigan State University.
- Mgonja, M., E. Monyo, D. Rohrbach, and M. Maredia. 2004. Regional plant breeding and variety registration: A case study of southern Africa. In D. Rohrbach, and J. Howard (eds.), *Seed Trade Liberalization in sub-Saharan Africa*. Bulawayo, Zimbabwe: ICRISAT.
- Setimela P.S., Z. Chitalu, J. Jonazi, A. Mambo, D. Hodson, and M. Bänziger. 2005. Environmental classification of maize testing sites in the SADC region and its implication for collaborative maize breeding strategies in the subcontinent. *Euphytica* 145: 123–32.
- Wobil J. 1998. 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. Pp. 217–26.
- Zulu, E. 2003. Experiences with variety testing, registration, and release, in SADC region. Regional technical meeting for formulation of SADC regional variety release system. 7–9 April, Gaborone, Botswana.

ISBN: 978-92-9059-252-5

