MOZAMBIQUE

IFDC

International Fertilizer Industry Association

IPNI International Plant Nutrition Institute

International Potash Institute 60 Anniversary 1952-2012

TSI The Sulphur Institute

Maize Intensification in Mozambique

Helping smallholder farmers increase maize production


MOZAMBIQUE
UNITED REPUBLIC OF TANZANIA
ZAMBIA
MALAWI
ZIMBABWE
SOUTH AFRICA
BOTSWANA
SWAZILAND
DEMOCRATIC REPUBLIC OF THE CONGO
INDIAN OCEAN
Mozambique Channel
Lake Bangweulu
Lake Chifungwe
Lake Malawi
Lake Nyasa
Licoma Is. (MALAWI)
Lake Malombe
Lake Chilwa
Lake Kariba
Lago de Cahora Bassa
Cahora Bassa Dam
Lusaka
Lilongwe
Harare
Pretoria
Mbabane
Maputo
NIASSA
CABO DELGADO
NAMPULA
TETE
ZAMBÉZIA
SOFALA
MANICA
INHAMBANE
GAZA
MAPUTO
Rovuma
Messalo
Lugenda
Lúrio
Ligonha
Licungo
Zambeze
Zambezi
Luangwa
Buzi
Save
Changane
Limpopo
Olifants
Cabo Delgado
Palma
Mocimboa da Praia
Mueda
Mecula
Quissanga
Pemba
Ancuabe
Montepuez
Namuno
Namapa
Metangula
Chiconono
Marrupa
Lichinga
Maúa
Mandimba
Cuamba
Memba
Nacala
Mecubúri
Ribáuè
Monapo
Mossuril
Moçambique
Nampula
Meconta
Murrupula
Nametil
Mogincual
Vila Junqueiro
Namarrói
Erego
Gile
Angoche
Ilha Angoche
Lugela
Milange
Moma
Pebane
Vila da Maganja
Morrumbala
Namacurra
Mopeia Velha
Quelimane
Marromeu
Chinde
Vila Gamito
Vila Coutinho
Furancungo
Fíngoè
Zumbo
Magué
Tete
Moatize
Changara
Chemba
Guro
Vila Fontes
Inhaminga
Manica
Chimoio
Sussundenga
Dondo
Beira
Chibabava
Espungabera
Nova Mambone
Inhassôro
Ilha do Bazaruto
Ilha Benguérua
Vilanculos
Ponta São Sebastião
Ponta da Barra Falsa
Mabote
Chicualacuala
Mapai
Massinga
Morrumbene
Inhambane
Massingir
Homoine
Panda
Inharrime
Guija
Chibito
Quissico
Magude
Manjacaze
Xai-Xai
Macia
Manhiça
Moamba
Namaacha
Boane
Bela Vista
National capital
Provincial capital
Town, village
Airport
International boundary
Provincial boundary
Main road
Railroad
0 50 100 150 200 km
0 50 100 150 mi
The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations.

Maize Intensification in Mozambique

Introduction

The Maize Intensification in Mozambique (MIM) project was implemented by the International Fertilizer Development Center (IFDC) from 2008-2012, with support from the International Fertilizer Industry Association (IFA), the International Plant Nutrition Institute (IPNI), the International Potash Institute (IPI) and the Sulfur Institute (TSI). The goal of the project was to increase the income and improve the livelihoods of smallholder farmers in Mozambique through intensified maize production.

The project was implemented in Manica, Nampula, Sofala and Zambezia provinces in the 2008-09 season, and in Manica, Sofala and Tete provinces in subsequent seasons.

Primary project activities consisted of:

- Establishment of demonstration fields with farmer groups.
- Field days to make farmers aware of yield-increasing technologies.
- Training of agro-dealers in the vicinity of farmer groups to increase the availability of inputs (seeds, fertilizers and crop protection products).

▲ *Cover image: A farmer stands in a maize field fertilized using the improved 21:20:0+5S+1Zn+0.5B formula, developed through MIM project research.*

◄ *Between 2008 and 2012, the MIM project conducted activities in Manica, Nampula, Sofala, Tete and Zambezia provinces.*

Demonstration Fields

*Table 1. **Locations of Demonstration Fields***

Province	District	Cropping Seasons			
		2008-2009	2009-2010	2010-2011	2011-2012
Sofala	Gorongosa	1	1	1	6
	Nhamatanda	1	1	2	-
Manica	Gondola	1	1	2	-
	Manica	1	1	2	-
	Sussundenga	-	1	2	-
	Báruè	-	1	1	4
Tete	Angónia	-	1	1	7
	Moatize	-	1	1	-
	Tsangano	-	1	-	-
	Macanga	-	1	2	-
Zambézia	Alto Molócuè	1	-	-	-
	Guruè	1	-	-	-
Nampula	Murrupula	1	-	-	-
	Malema	1	-	-	-
Total		**8**	**10**	**14**	**17**

Demonstrations fields (Table 1) were used to show the effects of fertilizers, improved seeds and good cropping practices (proper seed spacing and timely weeding) on maize yields. Table 2 shows average data from the first three years of demonstrations.

The farmer-saved seed treatment with no fertilizers represents the farmer practice in Mozambique. Farmer-saved seeds were compared with an open-pollinated variety (OPV) – Matuba and a hybrid – PAN 67. The basal fertilizers applied at planting in the first season were 12:24:12 and 12:24:12+6S, but only 12:24:12+6S in later seasons, based on the first season response. The differing nutrient quantities in the different seasons reflect the different quantities of fertilizers applied.

In all seasons, yields from improved seeds surpassed farmer-saved seeds, with the hybrid variety surpassing the OPV. The yield advantage increased with increasing fertilizer rates, showing the importance of using improved seeds with fertilizers to maximize returns on both. In the first season, fertilizer treatments containing sulfur (S) out-yielded those that did not by some 500 kilograms/hectare (kg/ha), showing that a lack of S was indeed limiting yields.

Despite the response to fertilizers, economic analyses showed that returns from fertilizer use barely offset the cost of fertilizers. Attention was turned to the basal fertilizer compound and its appropriateness for maize and the soil conditions in project areas. Thorough soil testing indicated deficiencies of phosphorus (P), S, boron (B), zinc (Zn) and possibly magnesium (Mg), while soil potassium (K) levels were generally sufficient for maize. Also, the quantity of nitrogen (N), generally the most deficient nutrient in maize production, is low in 12:24:12, though this is the most commonly used fertilizer in Mozambique.

The project therefore devoted the 2011-12 season to determining response to multiple nutrients, with the aim of developing a more efficient and profitable maize fertilizer. Treatments (Table 3 and Figure 1) were designed to distinguish the relative importance of N, P and K, and to evaluate the effects of secondary (S and Mg) and micronutrients (B and Zn).

Table 2. Demonstration Results, 2008-2011

2008-2009 Season, 8 sites			
Seed	Fertilizer (kg/ha)		Yield (kg/ha)
	Basal $N-P_2O_5-K_2O+S$	Topdress N as urea	
Farmer-saved	0	0	1,850
Farmer-saved	36-72-36	69	2,860
OPV	36-72-36	69	3,430
Hybrid	36-72-36	69	4,260
OPV	36-72-36+18S	69	3,900
Hybrid	36-72-36+18S	69	4,770

2009-2010 Season, 10 sites			
Seed	Fertilizer (kg/ha)		Yield (kg/ha)
	Basal $N-P_2O_5-K_2O+S$	Topdress N as urea	
Farmer-saved	0	0	1,110
Farmer-saved	6-12-6+3S	23	1,550
Farmer-saved	12-24-12+6S	46	2,100
Hybrid	0	0	1,670
Hybrid	6-12-6+3S	23	2,690
Hybrid	12-24-12+6S	46	3,110

2010-2011 Season, 14 sites			
Seed	Fertilizer (kg/ha)		Yield (kg/ha)
	Basal $N-P_2O_5-K_2O+S$	Topdress N as urea	
Farmer-saved	0	0	790
Farmer-saved	6-12-6+3S	23	1,360
Farmer-saved	12-24-12+6S	46	1,830
Hybrid	0	0	1,500
Hybrid	6-12-6+3S	23	2,220
Hybrid	12-24-12+6S	46	2,740

Figure 1. Maize Yield by Treatment, 2011-12

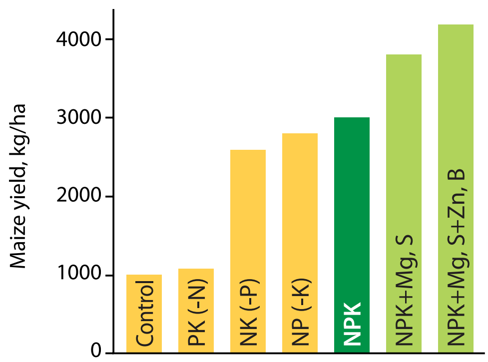

Table 3. Treatments Applied in 2011-12, and Maize Yields – Average of 17 Sites

2008-2009 Season, 8 sites								
Treatment	Nutrients Supplied in Fertilizers (kg/ha)							Maize Yield (kg/ha)
	N	P_2O_5	K_2O	Mg	S	Zn	B	
Control	0	0	0	0	0	0	0	1,000
PK (no N)	0	0	60	0	0	0	0	1,080
NK (no P)	90	0	50	0	0	0	0	2,590
NP (no K)	90	46	0	0	0	0	0	2,790
NPK	90	46	60	0	0	0	0	2,990
NPK + Mg, S	90	46	60	25	33	0	0	3,800
NPK + Mg, S + Zn, B	90	46	60	25	33	3	1	4,180

The PK treatment (no N) resulted in a yield similar to the control, showing N to be the primary limiting nutrient. The NP treatment (no K) reduced yields by only 200 kg/ha compared to the NPK treatment, affirming soil test results that K levels were not seriously reducing maize yields. Addition of Mg and S to NPK increased yields by 810 kg/ha, and further addition of Zn and B increased yields by another 380 kg/ha, which is considerable given the small amounts of either nutrient required. The non-NPK nutrients in total resulted in a yield increase of 1,190 kg/ha, a 40 percent increase over NPK alone.

While only 17 demonstrations were run in 3 clusters in 3 districts (Table 3), the project collated soil analytical data from 54 sites in 9 districts of Manica, Sofala and Tete provinces. Low levels of S and B were indicated at almost all sites, whereas Zn levels were low at more than 50 percent of sites. Based on this, a fertilizer blend containing N, P, S, Zn and B was developed for testing in the 2012-13 season.

Agro-Dealer Training

The MIM project goal was to train 50 agro-dealers on input and output marketing. MIM trained 52 agro-dealers in 2009 and 62 agro-input dealers in 2010-11. These trainings were conducted together with IFDC's USAID-funded project Agricultural Input Markets (AIMS) and AGRA-funded project Mozambique Agro Dealer Development (MADD). These projects also trained other agro-dealers outside of the MIM project area. Each agro-dealer had a simple demonstration field utilizing inputs which they sell.

◀ *Nutrient deficiencies are observed when only NPK fertilizers are applied to maize.*

Farmer Field Days

Farmer field days were held at all demonstration sites just prior to harvest, when treatment differences were most pronounced. The field days served to connect farmers and agro-dealers who sell the demonstrated inputs.

◀ *Farmers in Mozambique show ears of maize produced from fertilized fields.*

▼ *On back cover: An agro-dealer shop in Mozambique sells improved seed, fertilizers and crop protection products.*

Farmer Adoption and Lessons Learned

▼ *The maize field on the left received a fertilizer blend of 23:21:0+5S, while the field on the right received a fertilizer blend of 21:20:0+5S+1Zn+0.5B – the healthier growth visibly demonstrates the benefits of the micronutrients Zn and B.*

Farmer adoption, particularly of fertilizers, was low. The primary reason for poor adoption was the disappointing yield response to the 12:24:12+6S fertilizer compound used during the first 3 years of the project. The project succeeded in showing that the secondary nutrient S and micronutrients Zn and B were constraining response to macronutrients. Furthermore, the 12:24:12+6S formulation contains limited amounts of N, which is the most deficient nutrient. The balanced formula 21:20:0+5S+1Zn+0.5B was developed based on the results of this project, and is showing considerable promise in farmer field testing in the 2012-13 season. Intensified, profitable maize production in Mozambique will require a balanced maize fertilizer as well as hybrid seed. ■

MOZAMBIQUE

Maize Intensification in Mozambique
c/o IFDC Mozambique
Av, FPLM, n. 2698
Recinto do Instituto de Investigaçao
Agraria de Mocambique (IIAM)
Edificio de Quimica e Biotecnologia –
1 Andar/Esquerdo. Porta 14
Maputo – Mozambique
Tel. +258 21 462 914
E-mail ifdcmozambique@ifdc.org

IFDC East & Southern Africa Division
c/o IFDC Kenya
icipe compound
Duduville – Kasarani, Thika Road
Nairobi – Kenya
P.O. Box 30772-00100
Tel. +254 (20) 863 2720 / 2722
Fax +254 (20) 863 2029
E-mail ifdckenya@ifdc.org

IFDC Headquarters
P.O. Box 2040
Muscle Shoals, Alabama 35662 USA
Tel. +1 (256) 381-6600
Fax +1 (256) 381-7408
E-mail general@ifdc.org
Website www.ifdc.org

To learn more about IFDC and its projects, or to download a selection of publications, please visit the IFDC website at www.ifdc.org.