Integration of Maize Lethal Necrosis Disease Management in Crop/Livestock Intensification to Enhance Productivity of Smallholder Agricultural Production Systems in East Africa – an Africa RISING Approach

Research Team

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Fig. 1. Maize field affected by MLN, Tanzania.

Background

Africa Research in Sustainable Intensification for the Next Generation (Africa RISING) is implementing research activities in East Africa (EA) using a Crop/livestock intensification approach to improve the productivity of smallholder agricultural systems in the region. Preliminary results on variety selection during the 2012 cropping season revealed that varieties are not a significant factor in bridging the current maize yield gap, while good agronomic and natural resource management are critical factors. This implies that the use of improved crop varieties combined with good crop and natural resource management in crop/livestock intensification would significantly improve the productivity of smallholder agricultural systems.

However, the outbreak and rapid spread of Maize Lethal Necrosis (MLN) in EA (**Figure 1**) has emerged as a big challenge to maize production and has significantly affected the productivity of smallholder maize based agricultural systems as well as the commercial maize production sector. Thus, the presence of MLN is a great set back to such improved systems and compromises achieving the anticipated progress. MLN results from mixed infection of maize plants with Maize chlorotic mottle virus (MCMV, genus Machlomovirus) and potyviruses and it has been established that it is Sugarcane mosaic virus (SCMV) in combination with MCMV causing MLN. Losses in maize due to MLN can be very heavy and can reach 100% where the disease pressure is high (**Figure 2**).

Fig. 2. Maize affected by MLN at Mara farm in Tanzania.

Results from initial screening of a large volume of pre-commercial and commercial maize varieties from EA have shown that most of the varieties are highly susceptible but some maize inbred lines and hybrids possess moderate tolerance (**Figure 3**).

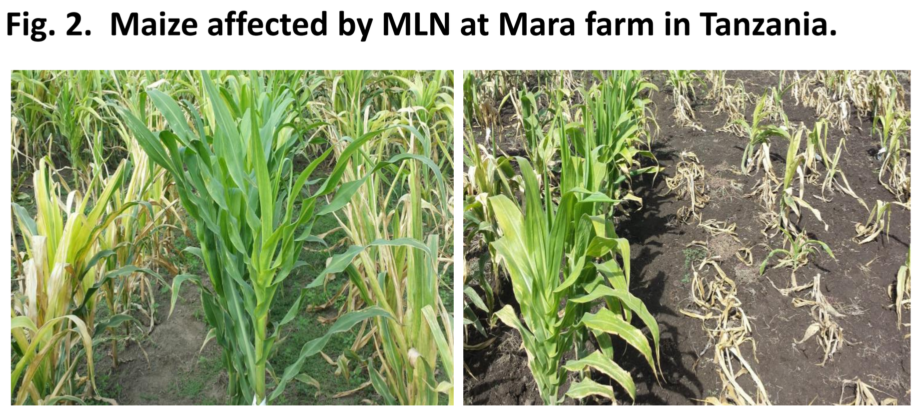

Fig. 3. Maize inbred lines showing moderate resistance to MLN under artificial inoculation.

To improve the resilience of crop/livestock smallholder production systems and enhance their productivity, the International Maize and Wheat Improvement Centre (CIMMYT) through Africa RISING program evaluated over 2,700 maize varieties for resistance/tolerance to MLN and determining their agronomic adaptability in Babati, Tanzania. We believe maize varieties with resistance to MLN will significantly contribute to the resilience of the crop/livestock smallholder production systems.

Materials and Methods

Thirty six trials with 2706 entries were planted, 18 at Mara farm, 5 in Seloto village, 7 at Matufa village and 6 in Karatu district, MLN hotspot areas in Tanzania, during the 2013/2014 crop growing season . These trials were planted using Alpha Lattice design with two replications for each trial and four commercial checks. Data collected include yield ($t\ ha^{-1}$) and other important agronomic traits such as plant height (cm), ear height (cm), ear rot (%), Lodging (%). Disease severity was not recorded as the disease pressure was very variable and symptoms in most cases came very late in the season after the crop had already flowered. These trials were planted in two sets, one set planted early January, 2014 and a second set planted in March 2014 to see if planting time has any importance as a measure of managing MLN.

Results

Table 1. Mean Grain yield and other important agronomic traits for the top performing hybrids among the 2706 experimental hybrids evaluated in Babati under natural MLN infestation.

Pedigree	Grain Yield ($t\ ha^{-1}$)	Plant Height (cm)	Ear Height (cm)	Ear Position	Ears Per Plant	Ear Rot (%)	Grain Moisture (%)	Number of Plants
CKH122206	8.1	205	111	0.5	2.0	20.5	17.1	12
CKH122255	7.2	218	121	0.6	1.4	28.2	20.6	11
CKH122251	7.1	189	108	0.6	1.5	15.0	16.8	12
CKH123730	7.1	216	111	0.5	1.1	5.9	18.3	14
CKH122157	6.8	198	111	0.6	1.2	10.9	17.3	12
CKH122244	6.6	201	113	0.6	1.3	29.7	16.4	14
CKH123995	6.5	220	123	0.6	1.2	41.2	18.5	13
CKH122159	6.4	203	125	0.6	1.6	19.0	17.0	9
CKH121957	6.3	194	103	0.5	1.0	15.9	19.8	15
CKH122253	6.2	221	122	0.6	1.7	24.0	17.7	11
CKH123729	6.0	224	118	0.5	1.1	14.0	16.3	14
SC 627	5.5	206	118	0.6	1.0	24.1	19.6	9
WH509	4.0	208	117	0.6	1.5	22.1	20.0	7
WH403	2.6	195	114	0.6	0.9	28.2	18.0	7
WH505	2.3	196	104	0.5	1.4	47.0	18.6	8
Experiment Mean	4.9	206	112	0.5	1.2	26.3	18.2	12
LSD (0.05)	3.0*	29	26	0.1	0.3*	26.9*	3.6*	4*
MSE	2.2	199	167	0.0	0.0	174.3	3.1	4
CV	30.1	7	12	8.7	13.5	50.3	9.6	18
Number of reps	2	2	2	2	2	2	2	2

*Significant at $P<0.05$

Analysis of variance showed that significant differences were present ($P<0.05$) among hybrids evaluated and experimental hybrids had higher grain yield ($8.1 tha^{-1}$) compared to commercial and local checks ($5.5 tha^{-1}$) (Table 1). These are preliminary results and considering the challenge that the disease pressure under natural infestation is highly variable, the performance of these hybrids is being validated during the 2014/15 crop growing season. Based on this, we also plan to evaluate the top performing hybrids under artificial inoculation.

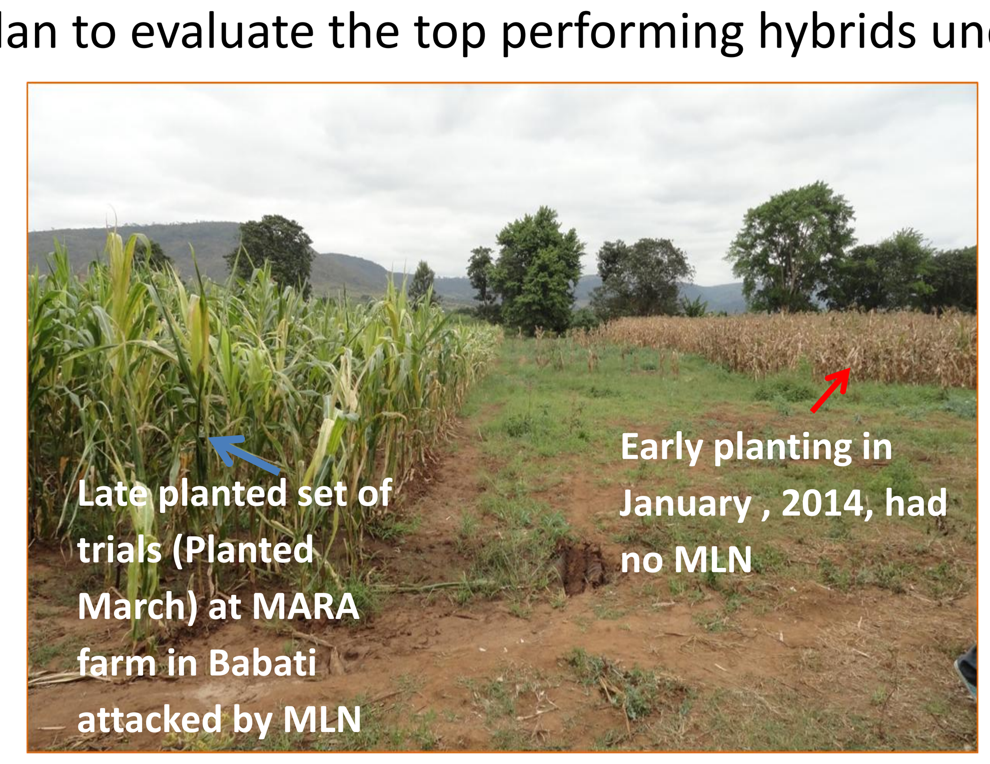

Fig. 4. Maize planted at different times during the 2013/1014 season.

A comparison of two sets planted at different times to determine if planting time has any effect on reducing MLN disease occurrence showed that planting late in the season (March in case of Mara farm) has the risk of having the disease while early planting did not show any disease symptoms (**Figure 4**). This experiment is also under validation during this 2014/2015 growing season.

Conclusion

If the results observed in these trials are confirmed, host resistance and cultural practices (crop rotation, field hygiene, use of certified seed, rogueing plants with symptoms of MLN) combined with good agronomic practices will have a significant role in managing MLN at farm level in EA.

Acknowledgement: We appreciate support provided for this work by USAID

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Africa RISING in East and Southern Africa is managed by IITA. The work on MLN in Babati, Tanzania, is being implemented by CIMMYT and IITA