FALL ARMYWORM DAMAGE IN AFRICAN SMALLHOLDER MAIZE FIELDS AND ITS IMPACT ON YIELD

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ABSTRACT

Fall armyworm (FAW, Spodoptera frugiperda J.E. Smith) is an invasive lepidopteran pest established in most of sub-Saharan Africa since 2016. Although the immediate reaction of governments has been to invest in chemical pesticides, control methods based on agronomic management would be more affordable to resource-constrained smallholders and minimize risks for health and the environment. However, little is known about the most effective agronomic practices that could control FAW under typical African smallholder conditions. In addition, the impact of FAW damage on yield in Africa has been reported as very large, but these estimates are mainly based on farmers' perceptions, and not on rigorous field scouting methods. Thus, our objectives were to understand the factors influencing FAW damage in African smallholder maize fields and quantify its impact on yield, using two districts of Eastern Zimbabwe as cases. A total of 791 smallholder maize fields were scouted for FAW damage during the 2017/18 season and the heads of the corresponding farming households were interviewed. Grain yield was later determined in 167 (about 20%) of these fields. The same FAW damage survey was repeated in 2018/19 with the same farmers. 638 maize fields were thus surveyed (153 farmers didn't plant maize that season). Grain yield was then determined in 386 (about 60%) of these fields.FAW damage was found to be significantly reduced by rotation with a legume or a fallow, legume intercropping, minimum- or zero-tillage, balanced fertilization, the application of manure and/or compost, frequent weeding and early planting, in at least one of the seasons under study. Conversely, the presence of a hedgerow and pumpkin intercropping was found to significantly increase FAW damage (during both seasons). FAW damage appeared significantly higher in plots receiving pesticides (during both seasons), suggesting poor efficacy of the pesticides or application method used. We also found evidence of varietal effects on FAW damage during both seasons.Our best estimate of the impact of FAW damage on yield was 11.57% in 2017/18, which is much lower than what previous studies reported. Although our study presents limitations, losses due to FAW damage in Africa could have been over-estimated. In 2018/19, however, our estimate of FAW damage was double the 2017/18 estimate (22.37%), possibly because of an interaction between FAW and drought. This study demonstrates the viability of using agronomic management to control FAW in African smallholder conditions. It is guiding on-going work from CIMMYT and its partners to develop the most cost-effective practices. These include zero-tillage, push-pull and pheromone trapping in irrigated maize. Preliminary results from this empirical work are presented.

Understanding factors influencing fall armyworm (*Spodoptera frugiperda* J.E. Smith) infestation in African smallholder maize fields & quantifying its impact on yield


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Invasion of Africa & Asia in < 4 years…

Presence of fall armyworm in 2015/10

Source: EPPO Global Database & IPPC

Introduction

- Investing in chemical pesticides has been the immediate reaction of African governments *(Harrison et al., 2019)*
- The use of chemical insecticides remains the main strategy of farmers to control FAW, but with mixed results *(Kumela et al., 2018)*
- Control methods based on agronomic management are likely more affordable for resource-constrained smallholders and represent a lower risk for health and the environment *(Thierfelder et al., 2018)*.
- But lack of data. Data from the Americas and 'anecdotal' observations made in the region (Harrison et al., 2019).
- Yield impact of FAW reported as very large *(ranging from 22 to 67% in Ghana and Zambia, Day et al., 2017)*.
- But these estimates are based on farmers' perceptions, not on rigorous field scouting methods *(such as the one proposed by McGrath et al., 2018)*.

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Objectives

1. To estimate fall armyworm damage in smallholder maize fields in two study Districts following a rigorous scouting protocol
2. To understand the factors influencing fall armyworm damage
3. To quantify yield losses due to fall armyworm damage.

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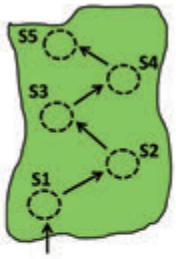
Assessment of **395** fields in Chipinge and **396** in Makoni in 2017-18

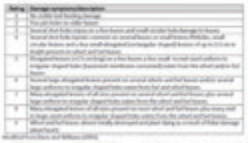
Assessment of **278** fields in Chipinge and **360** in Makoni in 2018-19



'W' sampling, 5 sampling points of 10 plants

	No. plants with leaf damage	No. plants with frass in the whorl	Damage score for the 10 plants
S1			
S2			
S3			
S4			
S5			

(from McGrath et al. 2018)

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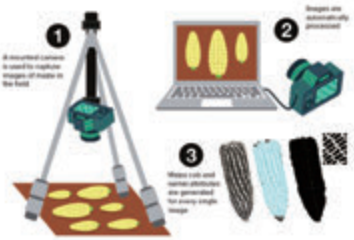
Yield data from 167 plots in 2017/18 and 386 plots in 2018/19

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FAW damage incidence and severity

Indicators	2017/18		2018/19	
	Chipinge	Makoni	Chipinge	Makoni
Leaf damage (%)	41.5 ± 28.7	54.9 ± 26.3	75.4 ± 21.8	49.4 ± 28.2
Damage score	3.74 ± 2.21	3.83 ± 1.96	5.32 ± 1.41	3.57 ± 1.85


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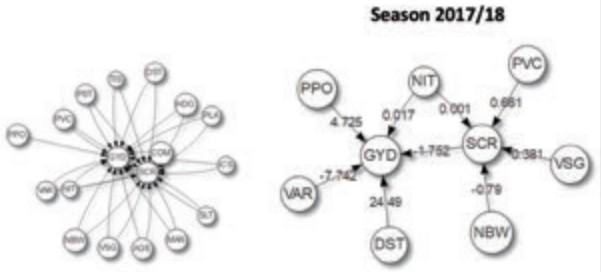
Factors influencing FAW damage

Practices	2017/18	2018/19
Pesticide application		
Presence of a hedgerow		
Pumpkin intercrop		
Maize variety		
Rotation with a legume or a fallow		
Legume intercrop		
Conservation agriculture		
Balanced fertilization		
Manure/Compost		
Frequent weeding		
Early planting		

Our best estimates of the impact of FAW infestation on yield losses



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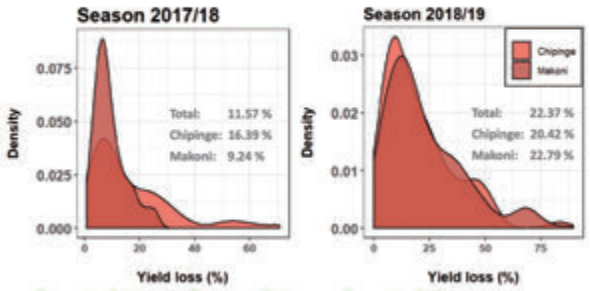

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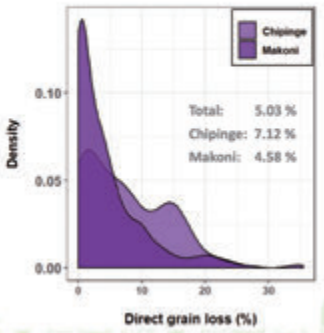
Estimates of the direct grain losses at reproductive stage in 2019



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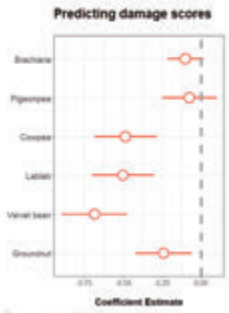
Adapting push pull systems to local conditions

(from Cook et al. 2007)



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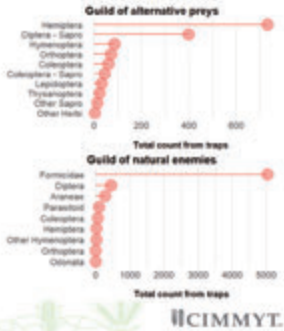
Nurturing natural enemies through legume intercropping and conservation agriculture



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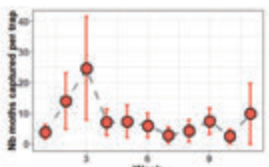
Pheromone traps in winter maize crops



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Conclusions

- Several agronomic practices appear to influence FAW infestation in smallholder conditions e.g., legume intercropping (not pumpkin!), conservation agriculture, and organic amendments

→ increase the abundance of natural enemies

- Some maize varieties appear more susceptible
- The effect of some factors appears to depend on season e.g. early planting, frequent weeding
- Yield losses also seem to depend on season, with perhaps an interaction between dry seasons/late planting and high damage and yield losses
- More research needed, in particular in farmers' conditions

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Thank you for your interest!

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