Cost-effective sampling and analysis of a cereal batch for mycotoxins

M. Focker[1], H.J. van der Fels-Klerx[1,2], A.G.J.M. Oude Lansink[2]

Background

In order to avoid cereal batches contaminated with mycotoxins to end up in the feed or food chain, batches need to be sampled and analysed.

The precision of a sampling and analytical (S&A) plan was evaluated by its total variance.
The total variance of a S&A plan is the sum of the variance related to:

1) taking samples at different locations in the batch
2) preparing the sample for the analysis
3) the detection method used to analyse the sample.

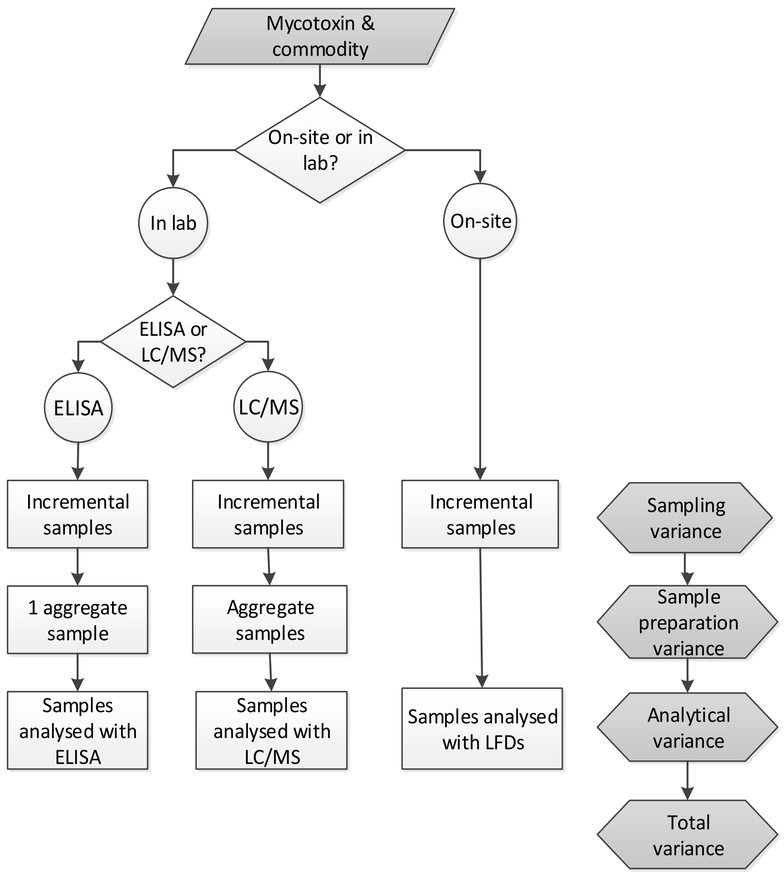

Figure 1. Three sampling and analytical plans considered using LFDs, ELISA or LC/MS

Objective

The objective of this study was to find a cost-effective plan for sampling and analyses of DON in wheat and for aflatoxins in maize.

Methods

An optimization model was developed:

- That maximized the number of correct decisions: the good lots accepted and the bad lots rejected;

- Subject to a budget constraint: the total sampling costs should be below the pre-set budget;

- By changing the number of incremental samples collected and the number of aliquots analysed.

Results

- From a budget of 500€ onwards, the optimal S&A plan is to collect samples, combine these into one aggregate sample and analyse one or multiple aliquots with ELISA (Figure 2, Table 1).

- The number of collected samples and the number of analysed aliquots will depend on the budget available.

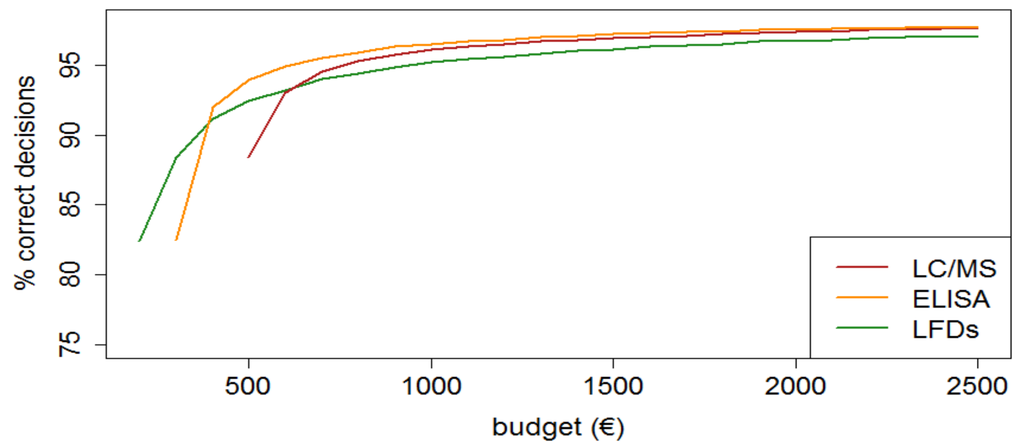

Figure 2. Percentage of correct decisions using the optimal sampling plan for 3 different detection methods (DON in wheat, guidance limit of 1250 µg/kg)

Table 1. Optimal solutions and % correct decisions for different budgets (aflatoxins in maize, limit of 4µg/kg)

Budget	D	H	E	ND	NH	NAH	NE	NAE	Correct decisions (%)
200	1	0	0	1	0	0	0	0	67.3
500	0	0	1	0	0	0	22	1	80.6
1000	0	0	1	0	0	0	71	3	85.5
1500	0	0	1	0	0	0	119	5	87.4
2000	0	0	1	0	0	0	167	8	88.6

Abbreviations used:
H, D, E: dummy variables for LC/MS, LFDs and ELISA respectively, that take the value of 1 when the detection method is chosen and 0 otherwise.
NH, ND, NE the number of incremental samples collected when LC/MS, LFDs or ELISA is used respectively
NAH, NAE the number of aliquots analysed when LC/MS or ELISA is used respectively

Conclusions

- Taking many samples, combining them and analysing a few subsamples with either ELISA or LC/MS leads to the highest number of correct decisions.

- LFDs is a suitable fast method for on-site detection, especially for DON in wheat, however more than 20 samples have to be taken and analysed in order to achieve an accuracy above 80% for both mycotoxins.

[1]RIKILT Wageningen University & Research
Akkermaalsbos 2 (building 123), NL-6708 WB Wageningen
Contact: marlous.focker@wur.nl
www.wur.eu/rikilt

[2] Business Economics, Wageningen University, Hollandseweg 1, 6706 KN, Wageningen, the Netherlands

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