Research and Methodology
Approach for the Evaluation of Maize Storage and Drying Systems on the Development of Post-Harvest Aflatoxin Contamination

Claudia Probst, Ph.D
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1. Definition of terms

**Accuracy** is defined as the closeness of measured values to the true value. Another term associated with accuracy is **bias**. A bias is some force or influence that makes the measured values deviate from the true value in a consistent manner on the average.

**Heterogeneous distribution** refers to a non-uniform distribution of the targeted substance (here: aflatoxin contamination of stored maize).

**Incubation** to ensure the presence of viable aflatoxin-producing fungi in the soon-to-be stored grains, and to jumpstart the growth and aflatoxin production by these fungi.

**Lot** is defined as the entire content of the storage device tested.

**Matched pair design** is a special case of the randomized block design. It is used when the experiment has only two treatment conditions; and participants can be grouped into pairs, based on some blocking variable. Then, within each pair, participants are randomly assigned to different treatments.

**Precision** is defined as the closeness of measured values to each other. Another term for precision is **variability**. The definition of precision makes no mention about how close the measured values are to the true value.

**Randomized complete block design**, the standard design for agricultural experiments. Each storage device in the test is replicated once in each block. All the storage devices are arranged randomly within a block and a new randomization pattern is used for each block. It is used to control variation in an experiment by accounting for spatial effects (here: variation in aflatoxin development).

**Random sampling** means that every maize kernel in the lot has an equal chance of being chosen.

**Repeated measure design**, also called a “within subject experiment”, takes measurements at two or more points in time on the same set of experimental units (here: treatments).

**Replicates** are the repetition of experimental conditions and used to measure variation in the experiment.
2. Detailed description of a systematic and practical experimental design including two rounds of testing

The experiments will be using both a randomized complete block design and a repeated measurement design (nested in the randomized complete block design).

Round 1: Pilot study (off farm)

a. Selection of experimental site

Experiments are carried out in Meru and Makueni districts in Eastern Province.

b. Storage devices

- Metal Silo (CIMMYT, local artisan) ~500kg total volume
- Plastic Silo (Kentainers) ~500kg total volume
- Bulk bag (GrainPro, GrainSafe™ Bag) ~1000kg total volume
- Hermetic bag (GrainPro, Super Grainbag) ~90kg total volume
- PICs bag (Developed by Purdue University) ~90kg total volume
- University of Leeds bag ~90kg total volume
- Control bag (poly-propylene bag currently used by farmers) on pallet ~90kg total volume

c. Terminology

Wet (maize) – maize moisture content of 15% (or above)

Dry (maize) – maize moisture content of 13.5% (or below)

Bad (maize) – aflatoxin contamination above the Kenyan regulatory limit of 10 ppb

Good (maize) - aflatoxin contamination below the Kenyan regulatory limit of 10 ppb

d. Assignment of treatments

1. Wet/ bad/ metal silo
2. Wet/ bad/ plastic silo
3. Wet/ bad/ bulk bag
4. Wet/ bad/ hermetic bag
5. Wet/bad/ PICs bag
6. Wet/bad/UoL bag
7. Wet/ bad/ control
8. Dry/ bad/ metal silo
9. Dry/ bad/ plastic silo
10. Dry/ bad/ bulk bag
11. Dry/ bad/ hermetic bag  
12. Dry/ bad PICs bag  
13. Dry/bad/UoL bag  
14. Dry/ bad/ control

Treatments differ in two factors: Moisture content and storage device used. So the treatment sum of squares can be split in a) Main effects, and b) interactions. Variability between treatments will be assessed.

e. **Number of replications per storage device**  
Each treatment will be tested in 6 replicates per District.

6 locations x 14 treatments x 2 Districts (Eastern)

f. **Duration of the pilot study**  
6 months

g. **Preparation of the maize used for the experiment**  
Maize used in this study should be locally produced. This will ensure that the maize is locally adapted and contains aflatoxin-producing fungi native to the area of interest.

Ideally, all maize should be purchased from one source within each testing region, e.g. from a local grain storage or one farmer. If maize cannot be purchased from one source, at least each replicate (each block) must contain maize from the same origin.

If after initial mixing the aflatoxin levels are lower than 50ppb, the grain will need to be incubated to increase the amount of spores (indicated by the presence of aflatoxin) throughout the grain.

Maize kernels have to be mixed thoroughly before the experiment is set-up. Therefore, all grain should be mixed in a big grain mixer (e.g. Cement mixer, V-mixer, ribbon mixer, double cone mixer) for a period of 12 to 24h. This elongated mixing period will ensure that the grain is homogenous and reduce the variance among replicates. One batch of maize will remain moist; the other batch has to be dried to 13.5% moisture (to obtain dry maize). Once the drying process is completed, moisture contents are assessed from multiple samples throughout the batches.

Maize from Meru District must not be mixed with maize from Makueni District

*For a graphical illustration, please see Annex 1a*

h. **Experimental design**

Experimental designs included in this study are the **Randomized complete block design** and the **repeated measure design.**
1. The **Randomized complete block design** compares aflatoxin reduction between treatments. The randomized complete block design is one of the most widely used designs. AflaSTOP investigates how several treatments (wet/bad/metal silo, dry/bad/metal silo and so on) affect a continuous response variable (aflatoxin development). Aflatoxin development after a fixed period is measured for each of the treatments in each of the blocks and is tabulated. Within each block, the conditions are as homogeneous as possible, but between blocks (in particular in between villages), large differences may exist. The treatments are assigned within the individual blocks at random with a separate randomization for each block.

   *The defining feature of the randomized complete block design is that each block sees each treatment exactly once!*

2. **Repeated measure design using a dependent or paired T-Test**, which is embedded into the complete randomized block design, compares aflatoxin development within a treatment (assess treatment effects within a storage device).

   AflaSTOP investigates how aflatoxin development changes in one treatment over time. For each treatment we have not a single measurement but a group of measurements (the repeated measures). The repeated measures consist of four samples taken at the beginning and at the end of the experiment. The design is embedded in the randomized block design. Again, we are modelling the variability within treatments. The mean aflatoxin level is computed out of four aflatoxin values obtained from four samples per treatment.

i. **Experimental set-up**

   Each block (6 per District) is treated as a replicate and will contain all treatments. Within each block, the conditions are as homogeneous as possible, but between blocks, large differences may exist. The treatments are assigned within the individual blocks at random with a separate randomization for each block. Identity of the blocks (meaning the physical housing) and the purpose for their use must be consistent throughout the experiment.

   **Figures 1a-c Examples of how to set-up the randomized complete block design**

   a) Each block = one location (e.g. a store in a village) = one replicate

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1Rift Valley and Eastern are given as illustrative examples in the below graphics.
b) Each block is divided into 14 even plots. Orient plots to sample the entire range of variation within the block.

c) The treatments (=storage devices) are positioned randomly to the compartments and are filled with the respective maize.
Take four 2kg composite samples (10 x 200g = 2kg) per treatment and determine aflatoxin content. These measurements will be used as a baseline (aflatoxin contamination and moisture content of experimental maize at T₀).

Each block will also be supplemented with a temperature and humidity reader (e.g. HOBO). These parameters will be used during statistical analyses to explain aflatoxin development.

- See sampling plan for a detailed description of the sampling procedure.

The sampling step is usually the biggest source of variability associated with aflatoxin analyses.

Aflatoxin contaminated kernels are not distributed uniformly throughout the lot (heterogeneous distribution). Therefore, the sample should be a composite of many small samples taken from many different locations throughout the lot (see Annex 2). A smaller sub-sample will be drawn from the composite sample for aflatoxin analyses. The aflatoxin concentration in the treatment (storage device) is assumed to be equal to the aflatoxin concentration measured in the test sample.

Samples will be taken according to the sampling plan (see below).
More samples will be taken at the beginning and end of the experiment. These additional samples are used for the repeated measure design (to evaluate variances within the treatments).

**Additionally:** Each block will contain two hermetic bags (GrainPro, PICs). Aflatoxin and moisture content will be assessed in both bags at the beginning of the experiment ($T_0$). One bag will be used for repeated sampling throughout the experiment. The other bag will remain closed (hermetic) until the end of the experiment. Here, the effect of continuous opening (as would be seen in farmers practices) on the hermetic nature of the bag will be compared.

**Important:** Samples will be analyzed for aflatoxin content by block (meaning by replicate) starting with replicate 1 (rep 1, treatment 1; rep 1, treatment 2; rep 1, treatment 3 ...rep 1, treatment 12; ...rep 6, treatment 1, rep 6, treatment 2; ..., rep 6, treatment 12).

### Sampling intervals

<table>
<thead>
<tr>
<th>Time</th>
<th>Month</th>
<th>No. of samples/treatment/replicate</th>
<th>Total no. of samples</th>
</tr>
</thead>
<tbody>
<tr>
<td>$T_0$ (start)</td>
<td>Month 1</td>
<td>4</td>
<td>672</td>
</tr>
<tr>
<td>$T_1$</td>
<td>Month 2</td>
<td>1</td>
<td>168</td>
</tr>
<tr>
<td>$T_2$</td>
<td>Month 3</td>
<td>1</td>
<td>168</td>
</tr>
<tr>
<td>$T_3$</td>
<td>Month 4</td>
<td>1</td>
<td>168</td>
</tr>
<tr>
<td>$T_4$</td>
<td>Month 5</td>
<td>1</td>
<td>168</td>
</tr>
<tr>
<td>$T_5$ (end)</td>
<td>Month 6</td>
<td>4</td>
<td>672</td>
</tr>
</tbody>
</table>

**Storage testing in different regions will be at different times based on the cropping cycles**

**Sampling plan** (also see Annex 3)

1. **Take 10 random samples (200g each)**
   - Grain probe, transect sampling
2. **Mix to obtain one 2kg composite bulk sample** (double re-sealable bag, label each bag)
3. **Grade grain: moisture content, kernel damage, insect count (if present) etc.**
4. **Grind in laboratory blender/ mill**
5. **Clean blender/ mill after each sample thoroughly!**
Homogenize in plastic bag (by inverting repeatedly)

Take one 50g Test sample (label)

Analyze samples for aflatoxin (and fumonisins) content

k. Data collection

1. Aflatoxin content (ppb) – determined with Lateral Flow Device
2. Fumonisin content (ppm) - determined with Lateral Flow Device
3. Moisture content (%) – determined with moisture reader
4. Insect damaged kernels (%) – determined on 100 random kernels
5. Moldy kernels (%) – determined on 100 random kernels
6. Live insect count – determined per 2kg sample
7. Dead insect count – determined per 2kg sample
8. Temperature & humidity – determined with temperature & humidity logger
9. GPS data

l. Evaluation criteria

Outcome from the Complete Randomized Block experiment:

- Differences in aflatoxin development based on moisture content, and storage device
- Difference in aflatoxin development between treatments (% reduction compared to control)

The statistical analyses will give you a realistic idea about the variance in aflatoxin development in your new storage devices. You compare the effectiveness of each device with each other and you will be able to say if the new device works with both wet and dry maize and compare it to the traditional storage used by farmers right now.

Outcome from the Complete repeated measure experiment:

- Differences in aflatoxin development for each treatment of each replicate
- Differences in aflatoxin development within a single treatment before and after

It gives you a realistic idea of the variability in your maize and if the replicates and treatments really are the same at the beginning -- even if they are not, this is okay with the repeated measures test. It will be accounted for with statistics!
You compare differences for each treatment of each replicate (if 6 replicates and 14 treatments then you have 24 comparisons per District) by comparing the four values before and the four after with a repeated measures test.

The second repeated measures comparison would use the means of the four samples for each of the 6 replicates as the replicate values (so for each treatment you have 6 values before (each is the mean of the 4 samples for each replicate) and 6 values after (again, each is the mean of the 4 samples for each replicate). Here differences within a storage treatment between before and after are tested (using all replicates).

All data will be analyzed by a statistician using an appropriate statistical program (such as SAS version 9.2; SAS Institute, Cary, NC)

m. Safety and Disposal

Equipment

All equipment that comes in contact with aflatoxins has to be soaked in a sodium hydrochloride (household bleach) solution (10% bleach, 90% tap water) for 30 minutes. Bleach will open up the aflatoxin ring structure and the toxin will be deactivated. Bleach also kills any microbes associated with the grain. After the bleach bath, equipment should be cleaned with water and detergent, and rinsed off with distilled water twice. Rinsing is important, since you want to remove any soapy residues (they will interfere with aflatoxin analyses).

Grain probes should be cleaned with 70% Ethanol (70% Ethanol, 30% water) in between sampling (squeeze bottle, make sure the Ethanol runs from the top to the bottom of the probe).

Grinder has to be cleaned in between every sample (remove all maize particles, spray down with 70% Ethanol, and wipe dry).

Pipette tips/Whatman filter paper should be disposed after each use. Collect them in a beaker filled with a water-detergent-bleach solution (very easy, fill the beaker with water and add a splash of bleach and detergent). Afterwards you can throw them in the trash.

Sample cups (with lids) can be re-used (save some money). Detoxify the cup in a sodium hydrochloride and water (10:90) solution, wash the cup with water and detergent, and rinse the cup with distilled water (at least twice) to remove any residues.

Surfaces

Surfaces should be wiped down with a sodium hydrochloride/water (10:90) solution. Aflatoxin residues on surfaces are deactivated by contact. The surface should be cleaned with a household detergent (e.g. Lysol) or a laboratory cleaning detergent to remove bleach residues (bleach will form a white crust on your surface).
**Disposal**
Experimental maize (sample maize) will be incinerated. All laboratory disposables like used tips must also be incinerated. All reagents must be labeled including buckets for washing and cans for collecting disposables. Labeling must show if the contents will be autoclaved or incinerated.

**Personal safety**
Gloves (nitrile), a laboratory coat and goggles are a must! Also a pair of designated shoes to avoid carry-over effects (you don’t want to carry aflatoxin-producing fungi to your house).
Round 2: Farmer testing in Eastern Province

Upon identification of a suitable new storage device (meaning a storage device that prevents aflatoxin development in both wet and dry maize post-harvest), the respective device will be tested by farmers in the Eastern Province.

a. Selection of experimental site
Farmers will be tested both in Eastern Province (center of acute aflatoxicosis outbreaks).

b. Duration of the study
6 months

c. Treatment arms
The goal of the study will be to assess if:

a) Farmers like the new device and, hence, are likely to buy such a device in the future;
b) Farmers need an initial training in order to use the storage device;
c) Function of the new storage device is influenced by day-to-day farming practices.

d. Experimental design: Matched pair study
A matched pairs design is a special case of the randomized block design. It is used when the experiment has only two treatment conditions; and participants can be grouped into pairs, based on some blocking variable (e.g. household structure, traditional storage system used, average amount of maize harvested, duration of storage). Then, within each pair, participants are randomly assigned to different treatments (with prior training or without prior training).

Prior to the study, a simple questionnaire is used to assess farmers (demographics, storage and drying habits, storage problems etc.). For sample questions, please see below. Based on the questionnaire, farmers should be matched into pairs (similar demographics, volume of maize stored etc.).

Farmers will be assigned to one out of two groups:

Group 1: Farmers receive an initial training on set-up and usage of the new storage device;
Group 2: Farmers will not receive an initial training on set-up and usage of the new storage device but will be handed the manufactures instructions.
Both groups will be advised to store their own, homegrown maize in the new storage device, and proceed to use the device in their everyday living.

e. Number of participants (pairs)

25 pairs of farmers are chosen per Province. The number of pairs should be sufficiently high, since drop-outs (e.g. farmer sold all his maize during the study, farmer decides not to use the device, farmer bought some more maize) are likely.

f. Sampling

Sampling follows the same procedure as described above. The initial sampling will assess the baseline aflatoxin contamination for each farmer. Follow up samplings will evaluate the development of aflatoxins in the new storage device (if any). Sampling intervals should be chosen based on the average volume of maize stored, since maize may be consumed or sold during the study period.
## g. Sample questions for farmers to assign groupings and storage habits

<table>
<thead>
<tr>
<th>General</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size of household</td>
</tr>
<tr>
<td>Age of household members</td>
</tr>
<tr>
<td>Are you able to makes storage decisions?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Storage practices</th>
</tr>
</thead>
<tbody>
<tr>
<td>When is the harvested maize stored? Directly after harvest?</td>
</tr>
<tr>
<td>How do you dry the maize? And, for how long?</td>
</tr>
<tr>
<td>For how many months do you store?</td>
</tr>
<tr>
<td>What storage method do you use?</td>
</tr>
<tr>
<td>Where is your storage structure located?</td>
</tr>
<tr>
<td>Do you store other products in the store, together with maize?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Storage problems (second round of questions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do you have storage problems?</td>
</tr>
<tr>
<td>Which storage problem is the most important? Insects/Rodents/Birds/Mold</td>
</tr>
<tr>
<td>What did you do to solve this problem?</td>
</tr>
<tr>
<td>Does the grain germinate in storage?</td>
</tr>
<tr>
<td>Do you clean the store before storage?</td>
</tr>
<tr>
<td>Do you remove old grains?</td>
</tr>
<tr>
<td>What else did you do to clean the store before storage?</td>
</tr>
<tr>
<td>How did you store your maize? As grain/in the husk/Dehusked</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Interest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Are you interested in testing a new storage device?</td>
</tr>
<tr>
<td>Are you interested in affordable drying devices? (second round)</td>
</tr>
</tbody>
</table>
Do you know about any other storage and drying devices besides the one you use?
h. Data collection

1. Baseline assessment
   a. GPS data

2. Sampling:
   a. Aflatoxin content (ppb) – determined with Lateral Flow Device
   b. Moisture content (%) – determined with moisture reader
   c. Insect damaged kernels (%) – determined on 100 random kernels
   d. Moldy kernels (%) – determined on 100 random kernels
   e. Live insect count – determined per 2kg sample
   f. Dead insect count – determined per 2kg sample
   g. Temperature & humidity – determined with temperature & humidity logger

3. Farmer liking:
   a. Problems with the device
   b. How often was the device opened?
   c. How much maize was eaten/ sold?
   d. etc.

i. Data evaluation

All data derived from sampling will be analyzed by a statistician using an appropriate statistical program (such as SAS version 9.2; SAS Institute, Cary, NC).

Information derived from questionnaires (Farmer liking) will be analyzed by the AflaSTOP team in Nairobi, Kenya.
3. Development and assessment of new on-farm drying technologies suitable for small-scale farmers in Kenya

a. Background

Losses of maize occur throughout the post harvest system. Storage and preceding drying are interdependent and invariably determine the success of both. Grain moisture highly influences the degree of post-harvest losses. Maize has to be properly dried to moisture levels of 12-13 percent to inhibit fungal growth and subsequent mycotoxin development, maintain seed viability, and increase storage life. However, farmer’s choice of drying method and duration are influenced by various factors, e.g. average income, weather, and fear of theft. Currently, there are no alternative drying technologies adapted to smallholder farmer production levels available in East Africa.

Development of alternative drying technologies become in particular important if

- Improved storage methods solely work with dried grains;
- Farmers have already invested in storage and are unwilling to make additional storage investments - but their grain is still in need of proper drying before storage;
- Farmers increase productivity and traditional methods become too labor and time intensive

b. Goal of the study

Goal will be to explore alternative drying technologies affordable and acceptable by small-scale farmers in East Africa. Therefore, a variety of existing (either previously or newly developed) drying technologies and their efficacy in drying maize to safe moisture levels shall be investigated.

c. Preliminary assessment of prototypes

Prototypes will be pre-tested based on the following criteria:

**Affordability**

- Initially cost to purchase the unit (capital cost)
- Costs associated with maintaining and running the unit (operating costs)
- Labor and technical support costs

**Availability**
- Access to technical support and replacement parts
- Physical infrastructure (delivery into rural areas)
- Power (solar, diesel, biomass)
- Production site (local, abroad or self made)

**Efficacy**

- **Consistency**
  - Prototype dries maize to desired moisture level: Always? Most times?
  - Desired moisture level is achieved independent from initial moisture content?
  - Knowledge about initial moisture levels are a prerequisite?

- **Speed**
  - How long does it take to dry grain to desired moisture levels?

- **Level of simplicity (or difficulty)**
  - Self-explaining?
  - Level of training required?

All these criteria will determine if the drying technology meets the farmer’s needs and, hence, will or will not be accepted by the community.

d. **On-site assessment of the most promising prototypes**

After the initial assessment and experimental design work, the most promising prototypes (3 or more) will be tested in cooperation with the farmer (on-site). The goal will be to evaluate farmer acceptance, assess potential pitfalls, and refine the device to farmer needs.

Study participants should reflect the existing infrastructure ranging in average household income, harvest volume etc. A preliminary questionnaire (farmer assessment) is considered an asset in finding the optimal range. Eventually, the questionnaire distributed for the improved storage study can be used for this reason.

Participants will be presented with and trained in the usage of one prototype. Ideally, the drying device should be shared with four neighbors. Each prototype should be evaluated in replicates including the range (from the poorest to richest farmer) of farmers as described above.

At the end of the study, farmers will be questioned about problems, and their willingness to purchase a new drying technology or investment in a shared drying technology (community property or service provider).
e. **Manufacturing, awareness programs, and ownership**

The most successful prototype should be presented to local communities to promote farmer awareness and adoption of the technology. At the same time, manufacturing capacities and commercialization programs should be developed. Ownership is an important question. Who will obtain the legal rights to market the drying technology? Ideally the drying device should be marketed and distributed by a non-profit organization to ensure cost effectiveness for small scale and low-income farmers.
4. Annex

1 a) Workflow – Example of initial preparation of wet grain for pilot study

14 treatments will take care of the controls too as indicated on Pages 5 and 6.

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210 treatments is an illustrative example. More treatments may be used.
2. Heterogeneous distribution of aflatoxins in stored maize

Heterogeneous (non-uniform) distribution versus Homogeneous (uniform) distribution

- Aflatoxin contaminated maize kernel

Because aflatoxin contaminated kernels may not be distributed uniformly throughout the storage device (= heterogeneous distribution), the analyzed sample should be an accumulation of many small samples taken from many different locations throughout the lot.
3. Workflow – Example of Sampling

Aflatoxin concentration in storage unit is assumed to be equal to the aflatoxin concentration measured in a small sample.

Clean grain probe and grinder thoroughly between samples (70% Ethanol)

Sample in order (first rep 1, then rep 2 etc) and analyze for mycotoxins in the same order (rep 1, treatment 1, rep 1 treatment 2 etc.)

Aflatoxin (Fumonisin) analyses

Lateral Flow Test (Quantitative)

Distributed by:
- Romer Labs
- VIGAM
- Charms
- Neogen

Remove 100 kernels and assess:
- Insect damaged kernels
- Moldy kernels

Whole sample, assess:
- Moisture content (%)
- Living insects
- Dead insects
4. **List of Material and Equipment**

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Material</th>
<th>Aflatoxin/Fumonisins analyses</th>
<th>Chemicals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grain mixer</td>
<td>Maize</td>
<td>Reveal Q+ for Aflatoxin</td>
<td>Ethanol</td>
</tr>
<tr>
<td>Grain probe</td>
<td>Batteries</td>
<td>Reveal Q+ for Fumonisins</td>
<td>Bleach</td>
</tr>
<tr>
<td>Moisture reader</td>
<td>Storage bags</td>
<td>Reveal AccuScan III Reader</td>
<td>Distilled water</td>
</tr>
<tr>
<td>Temperature and humidity logger</td>
<td>Cooler and ice pads</td>
<td>Reveal AccuScan III Software</td>
<td>Lab detergent</td>
</tr>
<tr>
<td>Grinder/ Mill</td>
<td>Gloves (nitrile)</td>
<td>Pipette (100 to 500µl)</td>
<td></td>
</tr>
<tr>
<td>Scale</td>
<td>Lab coat</td>
<td>Pipette tips (fit pipette)</td>
<td></td>
</tr>
<tr>
<td>Timer</td>
<td>Lab goggles</td>
<td>Whatman No 1 Filter paper</td>
<td></td>
</tr>
<tr>
<td>GPS device</td>
<td>Squeeze bottle</td>
<td>Sample collection cups w/lids</td>
<td></td>
</tr>
<tr>
<td>Sprayer</td>
<td>Wipes</td>
<td>Sample collection tubes with caps</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reveal sample cup rack</td>
<td></td>
</tr>
</tbody>
</table>