ZeroFly® Storage Bag

The first insecticide-incorporated polypropylene storage bag

zerofly.com
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ZeroFly®
Storage Bag | by VESTERGAARD

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Food Security & Post-Harvest Losses

As we approach 50 years post Green Revolution, food security remains a global problem with 1 in 8 still going hungry. Global hunger affects nearly a billion people and approximately one-third of food produced for human consumption is either lost or wasted. Addressing the post-harvest loss issue is critical to achieving global food security and global development.

Food losses not only reduce the availability of food, but also farmer's incomes; this in turn creates a negative cycle, increasing poverty, food prices and reducing people's ability to buy food when it is needed most.

The key question remaining is "When solutions are available, why are post-harvest food losses still a persistent challenge?" Particularly in developing regions, where as much as 30% of food produced per capita is lost or wasted.

A key area where food losses could be avoided is at the storage phase and the correct storage of commodities is arguably the most important and critical post-harvest operation.

Improper storage conditions introduce opportunities for insect infestation, fungal contamination and rodent attack. Grain is not only damaged and lost, but quality is also reduced with toxic mycotoxins produced by the fungal growth.

Current protection practices have challenges with non-optimal harvesting methods; such as improper drying and repeated use of pesticides. Improper drying results in fungal growth and quality loss in grain due to toxic mycotoxin contamination from the fungal growth. The need for repeat intervention of insecticide treatments over prolonged storage periods (6 months – 2 years) brings in concerns with applicator safety, environmental contamination and insecticidal residues on food commodities.

The limited success in reducing post-harvest losses highlights the urgent need to provide better practices, innovative technologies and practical recommendations at scale throughout the most at risk regions.

1/3

One third of all food production world-wide gets lost or wasted. This amounts to 1.3 billion tonnes per year.

Source: http://www.fao.org/save-food/resources/keyfindings/en/

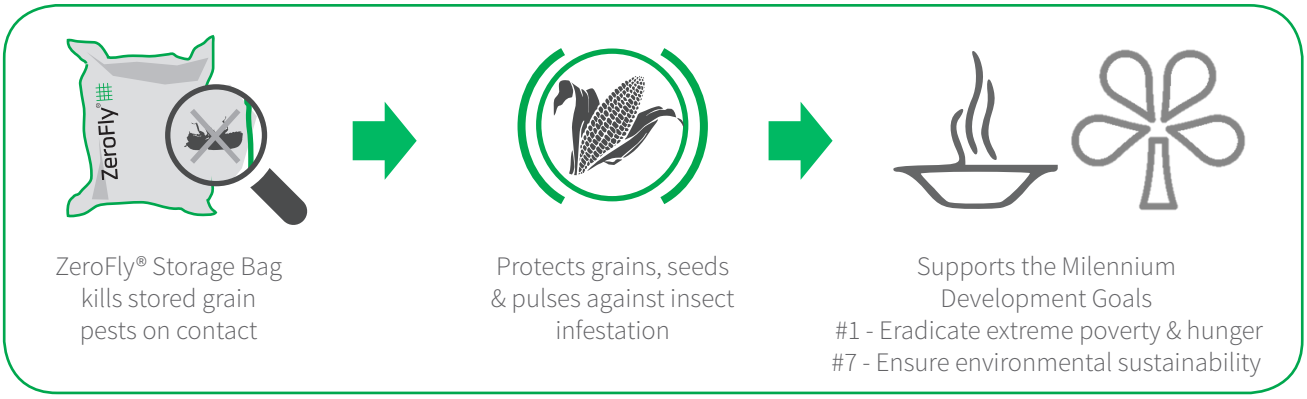
The Concept

ZeroFly® Storage Bag is an insecticide-incorporated woven polypropylene bag developed for post-harvest storage of commodities including cereal grains, pulses, oilseeds and seeds.

Innovative Technology

The active ingredient, Deltamethrin, is a Food and Agriculture Organization (FAO) and World Health Organization (WHO) approved pesticide for controlling insect pests. The active ingredient is incorporated into the individual yarns and slowly released onto the surface of the material in a controlled and sustained manner. The commodities stored in the bags are therefore continuously protected against insect infestation for the lifetime of the product.

How it works



Post-Harvest Pest Control Solutions

	ZeroFly® Storage Bags	Fumigation	Spraying	Grain protectant (dust)	Hermetic bags
Pest control efficacy	✓	✓	✓	✓	✓
No repeated intervention required	✓	×	×	×	✓
No risks for environment	✓	×	×	×	✓
No specialized expertise required	✓	×	×	×	✓
Suitable for large-scale stacking	✓	N/A	N/A	N/A	×
No vulnerability to insect damage	✓	N/A	N/A	N/A	×
No toxicity risks for food consumers	✓	✓	×	×	✓
No toxicity risks for operators	✓[1]	✓[2]	✓[3]	✓[4]	✓

Personal Protection Equipment (PPE) recommended on the products' labels to ensure operators' safety

[1] Gloves
[2] Gloves, full face mask
[3] Gloves, face mask, protective eyewear, coveralls, boots
[4] Gloves, face mask, protective eyewear, coveralls

Tested & Proven to Control

Weevils

Rice weevil
Sitophilus oryzae
Attacks rice, wheat & barley

Maize weevil
Sitophilus zeamais
Attacks grains

Granary weevil
Sitophilus granarius
Attacks all small grains; wheat, corn/maize, rye, oats, barley, sorghum

Borers

Larger grain borer
Prostephanus truncatus
Attacks corn/maize & wheat, bores into coffee & rice

Lesser grain borer
Rhyzopertha dominica
Attacks all grains & seeds, especially wheat, barley, sorghum, rice

Groundnut borer
Caryedon serratus
Attacks groundnuts

Beetles

Confused flour beetle
Tribolium confusum
Attacks corn/maize & wheat, other stored food products

Red flour beetle
Tribolium castaneum
Attacks stored grains & oilseeds, as well as beans & spices

Khapra beetle
Trogoderma granarium
Attacks grain & seeds

Pulse beetle
Callosobruchus maculatus
Callosobruchus chinensis
Attacks legumes, such as cowpeas, beans, green grams

Moths

Indian meal moth
Plodia interpunctella
Attacks cereals, grains, oilseeds, cocoa, spices, nuts & some pulses

Angoumois grain moth
Sitotroga cerealella
Attacks corn/maize, rice, sorghum, millet, wheat

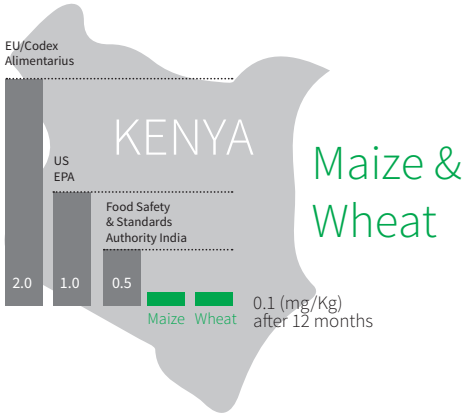
ZeroFly® Storage Bag Advantages

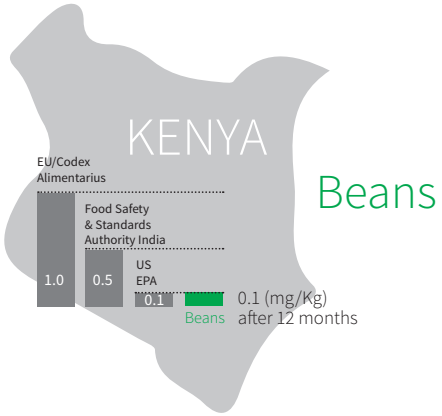
Grain Quality Protection	Stored commodities are protected by reducing the insect damage. Commodity's quality and marketability are maintained.
Seed Viability Protection	Seed viability of stored seeds is protected.
Proven Effectiveness	Tests in several internationally renowned institutes concluded that the bags are "effective," insects are killed, their entry into the bags is prevented and 'community effect' is provided, by reducing insects population in the storage area.
Long Lasting Protection	Effectiveness of a minimum two years is ensured through sustained release and controlled migration of the active ingredient to the surface of the yarns.
Superior Quality	Internationally recognized quality standards for storage bags are followed, quality assurance tests are conducted to ensure standards are met.
Safe	A "Food safe" classification received under US & EU regulations. Insecticide residues in the stored commodities are below the most stringent global standards. Tests showed no migration of polyolefins from the bags onto the food commodities. Total heavy metal content was below detectable limits & met USDA requirements.
Easy to Use	Regular re-application of insecticides are not required. Limited protective equipment is required, compared to other pesticide interventions. Toxicity studies concluded the bags are safe to handle.

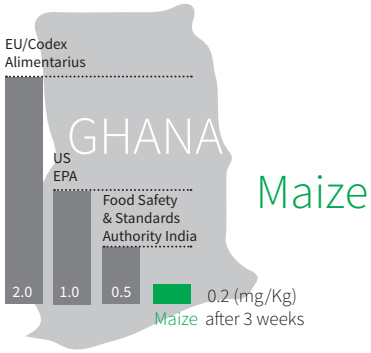
Food Safety Assessment

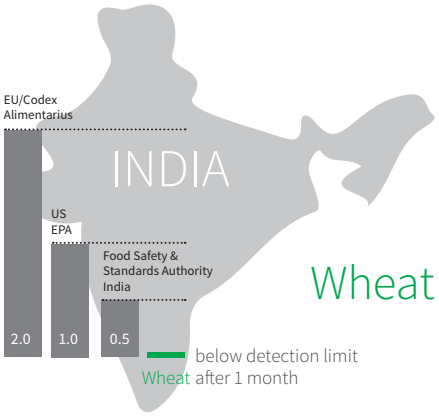
Commodities stored in ZeroFly® Storage Bags safe for consumption

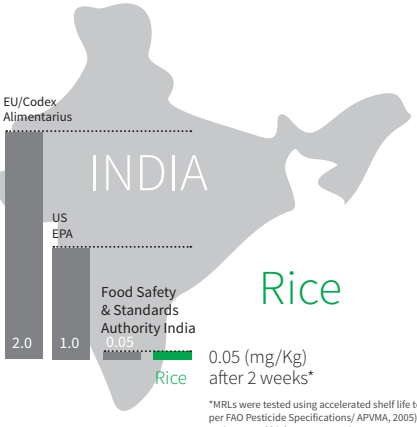
Multicountry studies have shown that when the commodities are stored in ZeroFly® Storage Bags during the intended use period, the residues found within the grains are below the strictest maximum residue limits (MRL's) available worldwide, including; Indian Standards (0.05 mg/kg of rice, 0.5 mg/kg of grain), Codex Alimentarius (2 mg/kg of grain), US EPA and EU country standards (2 mg/kg of grain). The product protects the commodity from damage whilst MRL's remain under the thresholds even when tested under some of the most challenging conditions the product is likely to be exposed to, such as high temperature, pressure and moisture.



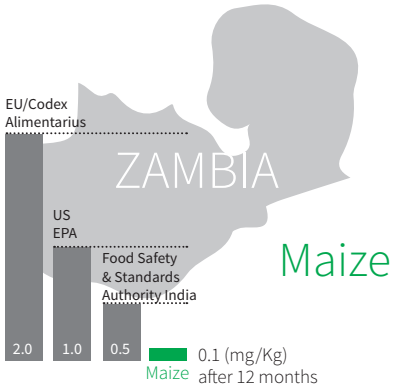


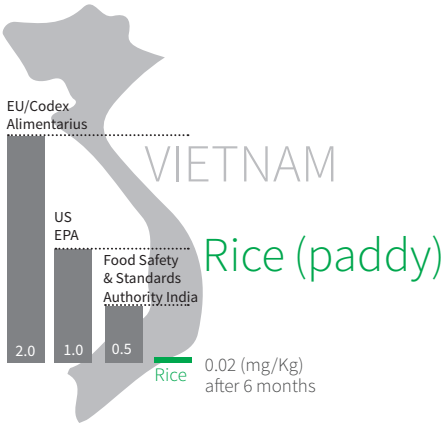


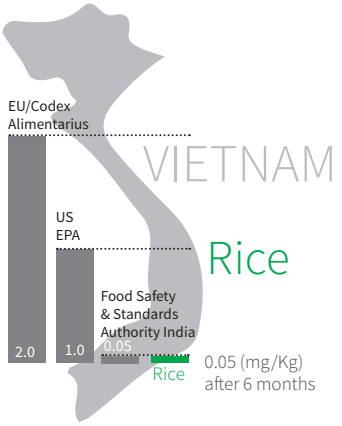




*MRLs were tested using accelerated shelf life test 54±2°C (as per FAO Pesticide Specifications/ APVMA, 2005) under high moisture and high pressure environments – equivalent of two years real time storage conditions.







Food Safety Assessment

Dietary Risk Assessment

Based on the Global Environment Monitoring System (GEMS) calculation, the Deltamethrin residues in commodities stored in ZeroFly® Storage Bags are 60% below acceptable daily intake (ADI).

Human Risk Assessment

Following human risk assessment, the product is considered safe for occasional handling in households. However, personnel handling the bags on a daily basis are advised to wear gloves and full sleeve shirts to minimize potential exposure to insecticide.

Heavy Metals

Arsenic (As), Cadmium (Cd), Lead (Pb), Hexavalent Chromium (Cr6+), Mercury (Hg) and Antimony (Sb) were **below detection limits** in ZeroFly® Storage Bag and therefore passed USDA EPA standards.

Migration of Polyolefins in Polypropylene

Test results have shown ZeroFly® Storage Bags to be "food safe" both under US and Europeans standards for plastic products coming into contact with food commodities.

Toxicity

Oral toxicity on rats: Globally Harmonized System (GHS) evaluated as category 5: **Safe**.

Acute dermal irritation/ corrosion potential was **non-irritant** to the skin of New Zealand white rabbits.

Minimally irritating (M1) to the eyes (New Zealand white rabbits).

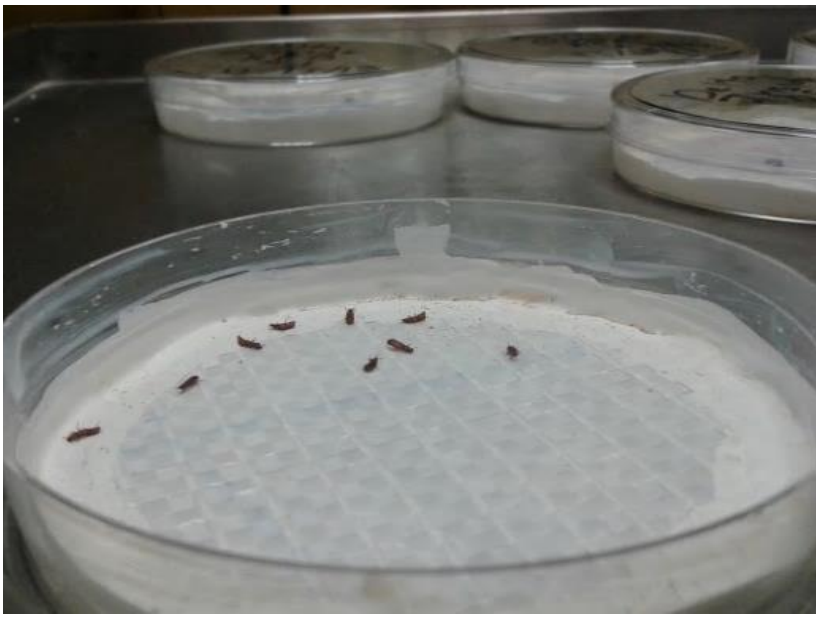
Non-sensitizer to the skin of guinea pigs.

Safe for consumers:
The residue of insecticide found in stored commodities does not exceed the Acceptable Daily Intake.


ZeroFly
ZeroFly

Research Evidence: Laboratory

USA: Eurofins Agroscience Services Inc., Cedar Grove NC



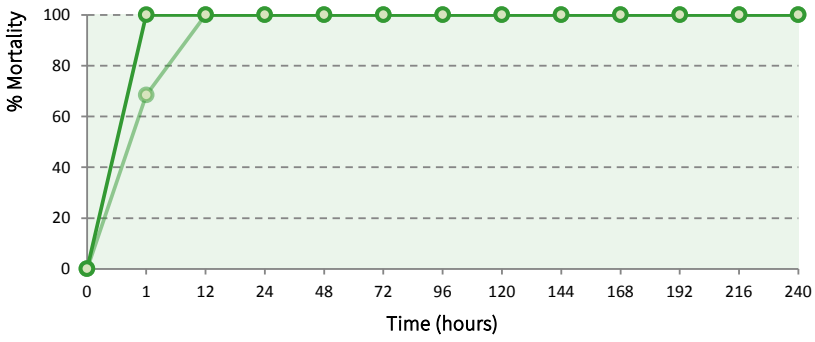
Granary weevil (*Sitophilus granarius*) adults showed 100% mortality and knock down when exposed to ZeroFly® Storage Bag for 24 hours.

Confused flour beetle (*Tribolium confusum*) larvae and adults showed 100% knock down 12 hours after exposure and 100% mortality at the end of the 7 days of observation.

The study showed that all adult granary weevils and adults and larvae of confused flour beetles were rapidly knocked down and killed and that neither pest was able to bore or chew through ZeroFly® Storage Bag.

UK: Natural Resources Institute, University of Greenwich, Chatham, Kent

Bioefficacy of ZeroFly® Storage Bags against Indian meal moth & Khapra beetles



Khapra beetle (*Trogoderma granarium*) and Indian meal moth (*Plodia interpunctella*) adults were exposed to ZeroFly® Storage Bag samples for up to 72h.

Knock down occurred at one hour and insects were dead after 24 hours.

100% mortality was observed for larvae at the end of the observation period of 14 days.

None of the exposed adults produced any offspring, whilst control adults bred successfully to produce viable larvae.

The study showed that all Indian meal moth & Khapra beetle adults were rapidly knocked down and killed by ZeroFly® Storage Bag. Reproduction of Indian meal moth was negatively impacted by exposure to ZeroFly® Storage Bag; eggs did not hatch nor develop further.

Research Evidence: Laboratory

India: International Institute of Biotechnology and Toxicology (IIBAT), Chennai

The efficacy of ZeroFly® Storage Bags was tested under laboratory conditions through contact assays with adult rice weevils (*Sitophilus oryzae*) and pulse beetles (*Callosobruchus chinensis*). The insects were collected from local households and warehouses, **and confirmed as 30-fold resistant to Deltamethrin** as compared to susceptible insects.

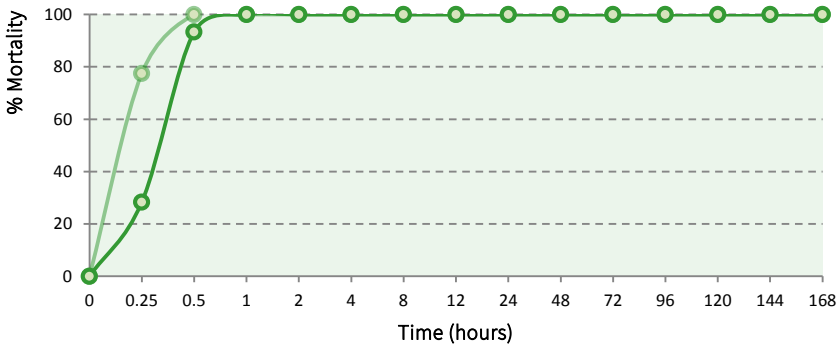
The efficacy of ZeroFly® Storage Bag samples against rice weevils and pulse beetles was established under laboratory conditions, and 100% knock down and mortality was achieved after 30 minutes and 24 hours exposure to the product respectively.

The efficacy of ZeroFly® Storage Bag after 20 days of real time exposure to Delhi summertime conditions (with average day temperatures ranging from 33 - 40°C), showed 100% and 80% mortality respectively, on pulse beetles after 30 minutes exposure, and on weevils after 24 hours.

The study showed that weevils & pulse beetles with 30-fold resistance to deltamethrin were rapidly knocked down and killed. None of the pests were able to bore or chew through ZeroFly® Storage Bag.

Ghana: Vestergaard-NMIMR Vector Labs, Accra

Bioefficacy of ZeroFly® Storage Bags against larger grain borers

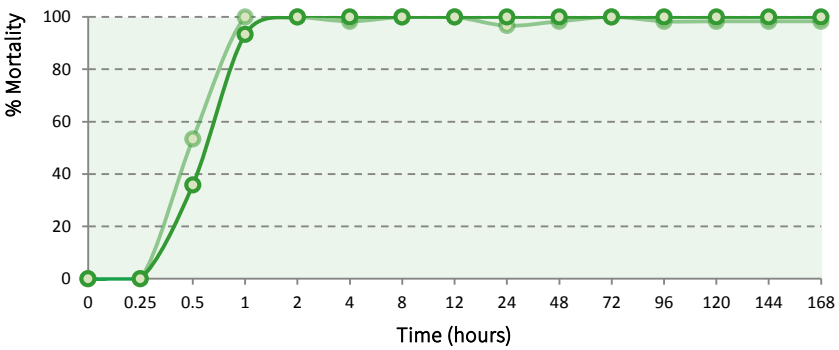


Fresh

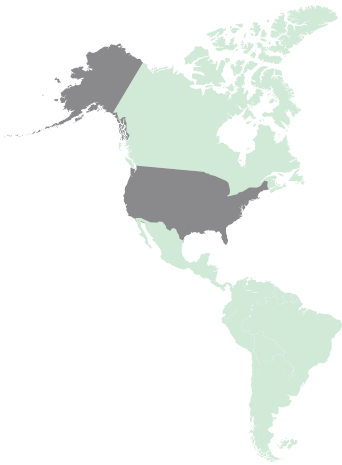
After 1 year of usage

Maize weevils (*Sitophilus zeamais*) and larger grain borers (*Prostephanus truncatus*) were exposed for 24 hours to freshly produced samples and to bags used under warehouse conditions for 1 year in Lusaka area, Zambia.

Bioefficacy of ZeroFly® Storage Bags against maize weevils



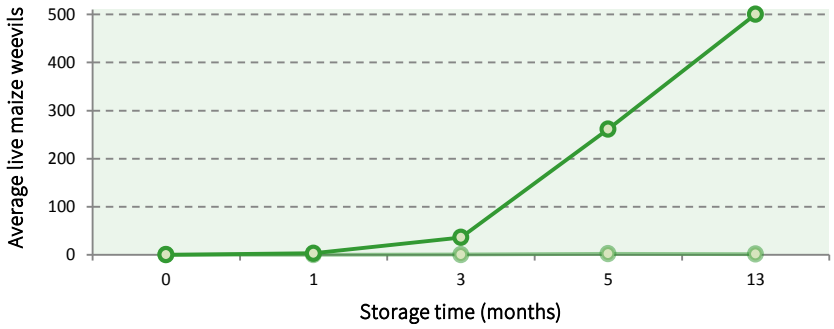
The study showed that ZeroFly® Storage Bag retained full bioefficacy against maize weevils & larger grain borers after 1 year of real time usage. Both pests were rapidly knocked down and killed by ZeroFly® Storage Bag.



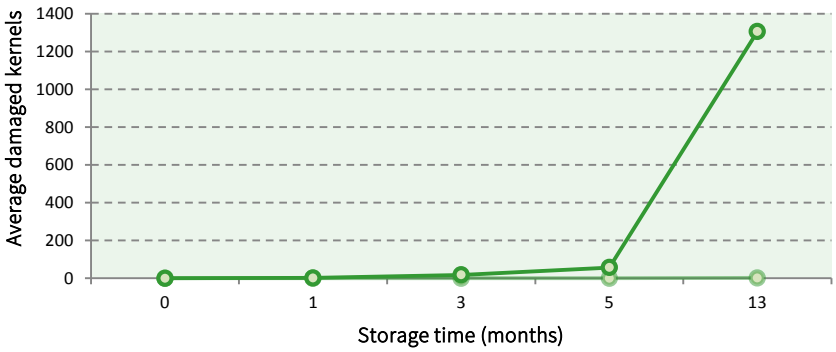
Research Evidence: Laboratory & Simulated Storage

USA: United States Department of Agriculture (USDA), Manhattan KS

Impact on maize weevil population growth in stored maize



Impact on grain damage during simulated storage period



ZeroFly® Storage Bags

Control (untreated PP bags)

ZeroFly® Storage Bags

Control (untreated PP bags)

In laboratory bioassays, red flour beetle (*Tribolium castaneum*), lesser grain borer (*Rhyzopertha dominica*) and maize weevil (*Sitophilus zeamais*) showed 100% knock down and mortality after a maximum exposure period of 72 hours to ZeroFly® Storage Bags.

In a simulated storage study, 500g bags made out of ZeroFly® Storage Bags and untreated polypropylene bags (as a negative control), were placed in controlled environmental chambers at 27.5°C and 65% RH, with either internal or external artificial infestation of insects.

A significantly higher number of insects ($P < 0.05$) were recorded in the control bags both with external and internal initial infestation. There were no live insects nor damaged kernels in treated bags with no initial infestation*.

Untreated control bags with both internal and external infestation had almost 100% damaged kernels after 13 months of storage.

*Some bags were damaged during the storage and therefore excluded from the statistical analysis.

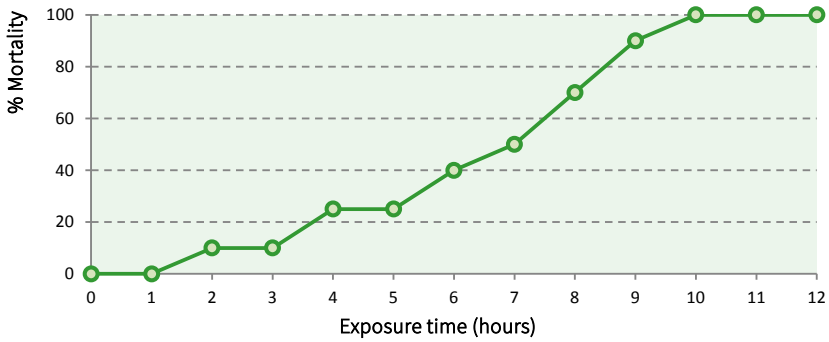
The study showed that all maize weevils, lesser grain borers & red flour beetles in contact with the ZeroFly® Storage Bags were rapidly knocked down and killed.

ZeroFly® Storage Bags effectively protected the stored maize for at least 13 months.

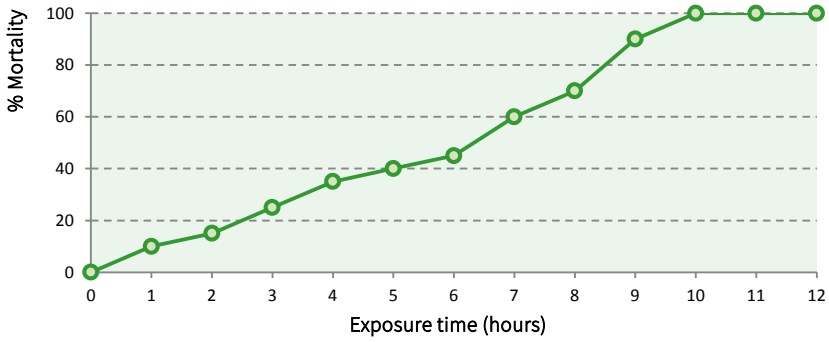
Research Evidence: Laboratory & Simulated Storage

Ghana: African Regional Postgraduate Program in Insect Science Laboratory, University of Accra

Bioefficacy of ZeroFly® Storage Bags against maize weevils



Bioefficacy of ZeroFly® Storage Bags against pulse beetles



Insect infestation during simulated storage with artificial infestation

Treatment	Bag Size	% Average Mortality (± SE*)	
		Maize weevils	Pulse beetles
ZeroFly® Storage Bag	5 Kg	100.0 (± 0.0)	99.5 (± 0.1)
	10 Kg	99.7 (± 0.1)	93.4 (± 1.3)
Control (untreated PP bags)	5 Kg	0.0 (± 0.0)	0.0 (± 0.0)
	10 Kg	7.0 (± 2.3)	0.0 (± 0.0)

*Standard Error

Insect infestation during simulated on farm storage with natural infestation

Treatment	Bag Size	Average no. live insects (± SE*)	
		Maize weevils	Pulse beetles
ZeroFly® Storage Bag	10 kg	0 (± 0)	1 (± 0)
Control (untreated PP bags)	10 Kg	128 (± 13)	142 (± 11)

*Standard Error

In laboratory bioassays with maize weevils (*Sitophilus zeamais*) and pulse beetles (*Callosobruchus maculatus*), 100% knock down and mortality effect was observed within 10 hours of exposure to ZeroFly® Storage Bags.

Under laboratory storage conditions, 5 and 10 kg bags of maize and cowpeas were artificially infested with 100 maize weevils and 200 pulse beetles for each of the crops respectively. After 3 weeks of observation, within the untreated 5kg control bags there was no mortality recorded, whilst an average of 7% mortality was recorded in the 10 kg control bags. ZeroFly® Storage Bags killed 93.7% maize weevils and 100% pulse beetles.

In simulated storage conditions, 10 kg bags were stored on a farm, under natural pest infestation and no live maize weevils and only 1 live pulse beetle were recorded within ZeroFly® Storage Bags. Within the untreated control bags 127 live maize weevils and 142 live pulse beetles were recorded for the same storage period of 3 weeks.

No weight loss was recorded for grain stored within ZeroFly® Storage Bags, whilst 9.37% and 16.24% weight loss was found in control bags for maize and cowpeas respectively after 3 months of storage.

Deltamethrin residues, 0.15 mg/kg of grain, on maize stored in ZeroFly® Storage Bags remained below Maximum Residues Limits (Codex & EPA) throughout the storage period.

The study showed that maize weevils & pulse beetles were rapidly knocked down and killed. ZeroFly® Storage Bags effectively protected maize & cowpeas against maize weevils & pulse beetle.

Research Evidence: Laboratory & Simulated Storage

Nigeria: Nigerian Stored Products Research Institute (NSPRI), Ilorin

In laboratory bioassays ZeroFly® Storage Bags showed 100% mortality with all insect species tested with 24 hours of exposure at 7 days of observation.

Under simulated storage conditions, ZeroFly® Storage Bags (10kg bags) were compared to local polypropylene (PP) bags with untreated grain (negative control), and bags with treated grain, Permethin dust, 0.06% a.i.* (positive control). Maize and cowpeas (500g) were artificially infested with pulse beetles (*Callosobruchus maculatus*), maize weevils (*Sitophilus zeamais*), lesser grain borers (*Rhysopertha dominica*) and red flour beetles (*Tribolium castaneum*) and then kept under observation and assessed at 7 and 25 days.

The ZeroFly® Storage Bags effectively protected all the commodities, recording 100% insect mortality, whilst live insects were found in all control bags after 25 days.

The commodities stored in ZeroFly® Storage Bags maintained higher grain quality and seed viability (93% germination rate), as compared to both negative and positive controls (53% & 54% respectively) after 3 months of storage.

*a.i. - active ingredient

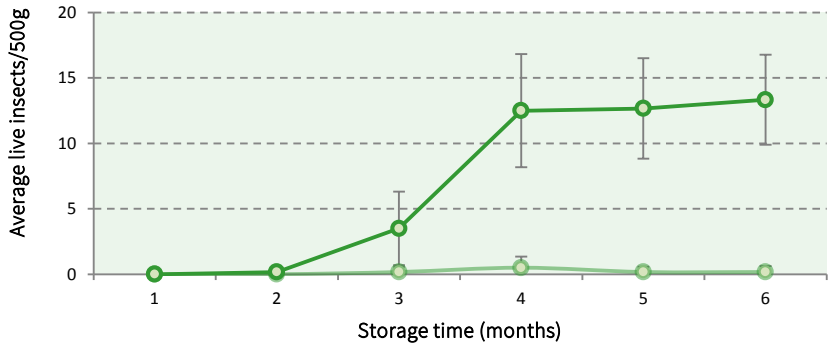
The study showed ZeroFly® Storage Bags effectively killed pulse beetles, maize weevils, lesser grain borers & red flour beetles within 24 hours of exposure and protected maize seed viability over 3 months of storage.

One of a farmer's most critical management decisions is the selection of a seed source and variety. The cost of seed stock is usually less than 5-10% of total production costs. Yet seed stock can affect the yield potential of a crop more than any other input.
Seed viability is negatively impacted by insect damage, as many pests are known to attack the seed embryo first, thus reducing future crop yields. Germination rate should be above 80%.

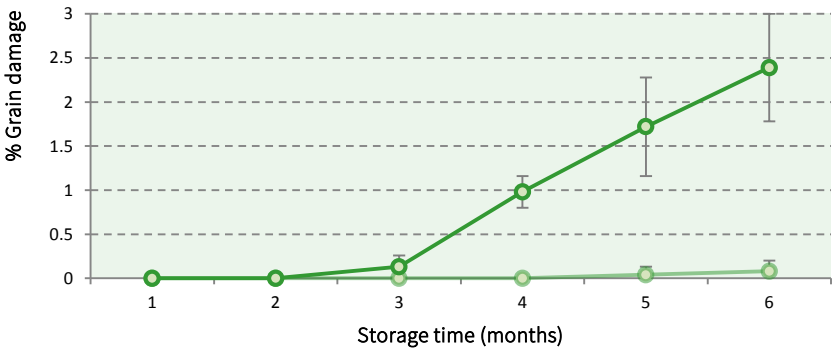
Research Evidence: Field

Vietnam: Sub-Institute of Agricultural Engineering & Post-Harvest Technology (SIAEP), Ho Chi Minh

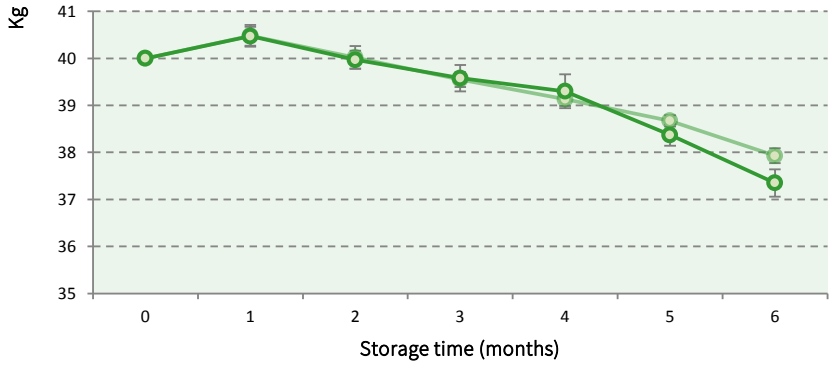
Impact on insect population growth in stored paddy rice



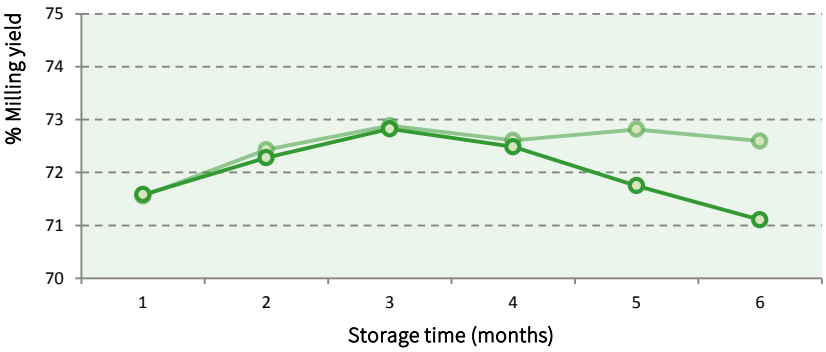
Impact on grain damage in paddy rice over storage period



Impact on paddy rice weight loss over storage period



Impact on milling yield for paddy rice over storage period



A field trial using paddy and milled rice was conducted in Ho Chi Minh area using 50 kg ZeroFly® Storage Bags compared with locally procured untreated polypropylene (PP) bags over a 6 month storage period.

The commodities were fumigated before bagging in order to eliminate insect infestation. Artificial infestation was carried out within the warehouse.

The damage of paddy rice grains was significantly lower in ZeroFly® Storage Bags after 4 months of storage. At 6 months, the weight loss was also significantly lower in ZeroFly® Storage Bags.

Insects in rice packed in untreated bags caused an increase in the percentage of broken rice over time, also resulting in decreased milling quality.

Along with weight loss, quality is also measured by milling yield, a measure of the percent of bran removed from the brown rice kernel. Milling is important to consumers, since unmilled brown rice absorbs water poorly and does not cook as quickly as milled rice.

ZeroFly® Storage Bags

Control (untreated PP bags)

Taste and color are also key aspects of consumer acceptance. These characteristics were measured on a five point Hedonic Scale, from 1 (very poor) to 5 (highly acceptable). Taste and odour profile of rice stored in ZeroFly® Storage Bags retained the original score. This was not the case for rice packed in untreated bags, where the rice had undesirable odour and taste, characteristic to the presence of insects.

Sensory evaluation results before & after storage

Paddy rice

		Before	After
Taste	ZeroFly®	4	4
	Control	4	2.2
Odour	ZeroFly®	3	3
	Control	3	1.7

Milled rice

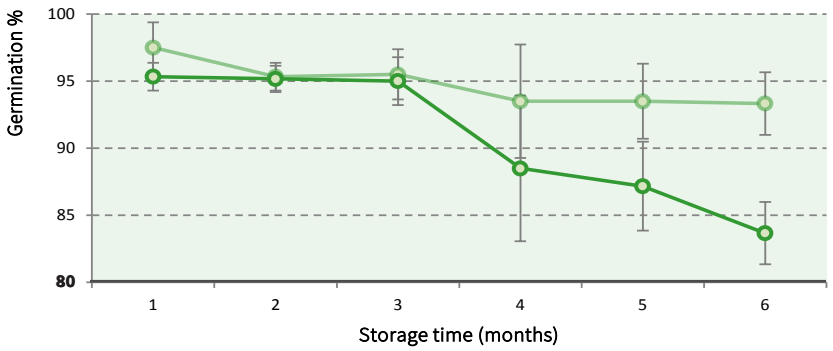
		Before	After
Taste	ZeroFly®	3	3
	Control	3	1
Odour	ZeroFly®	3	3
	Control	3	1

The paddy rice stored in untreated bags had significantly lower seed viability after 6 months of storage, with 84% for untreated bags vs. 93% for ZeroFly® Storage Bags.

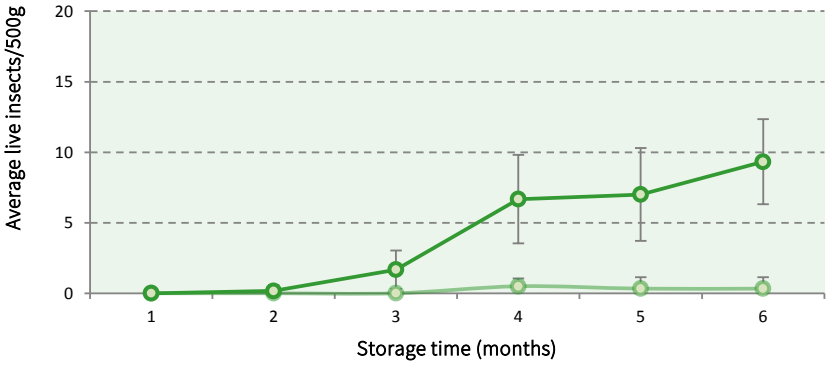
Deltamethrin residues of rice packed in ZeroFly® Storage Bags were sampled and analyzed. The recorded averages after 6 months of storage were lower than the Indian Standards (0.05 mg/kg of rice, 0.5 mg/kg of grain), Codex Alimentarius (2 mg/kg of grain), US EPA (1 mg/kg of grain) and European standards (2 mg/kg of grain).

Rice	Deltamethrin residues (mg/Kg)
Paddy	0.0185
Milled	0.0455

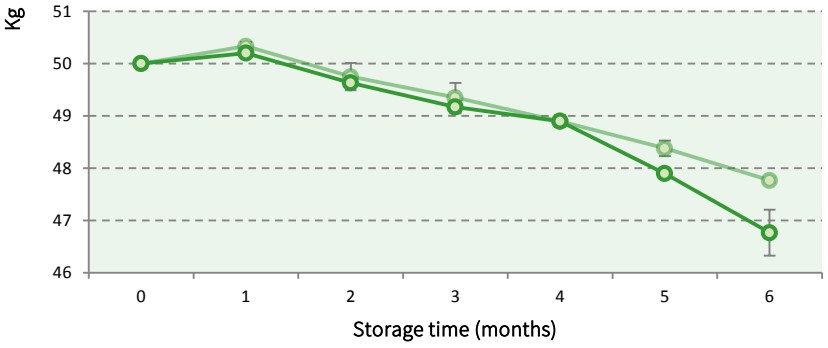
Impact on seed viability of paddy rice over storage period



Impact on insect population growth in stored milled rice



Impact on weight loss during storage of milled rice



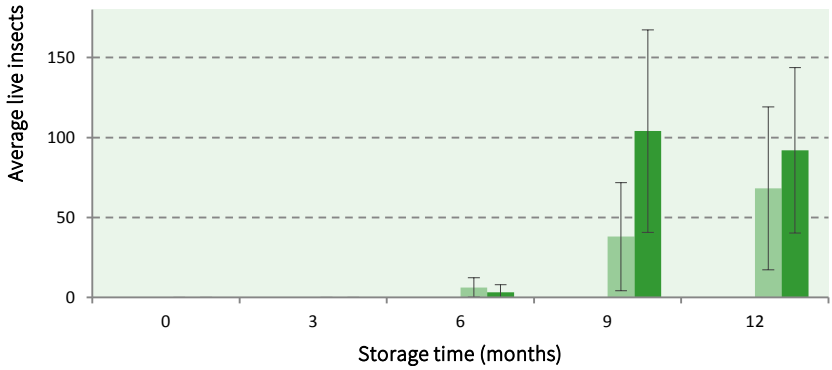
The study showed that the ZeroFly® Storage Bags effectively controlled rice weevil infestation and maintained high quality parameters of paddy and milled rice over the 6 months of storage. ZeroFly® Storage Bags maintained higher seed viability, higher milling quality and insecticide residues remained below the strictest global residue limits.

Research Evidence: Field

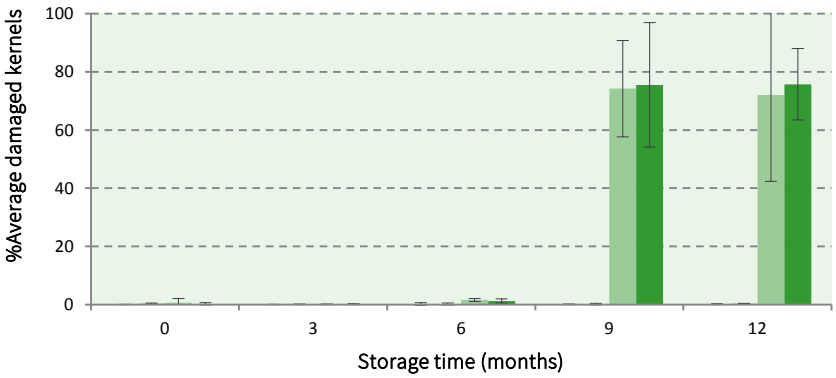
Zambia: Zambian Agricultural Research Institute (ZARI), Mt. Makulu

ZeroFly® Storage Bags
FRA bags with Shumba®
Control (FRA bags)
Control (PP bags)

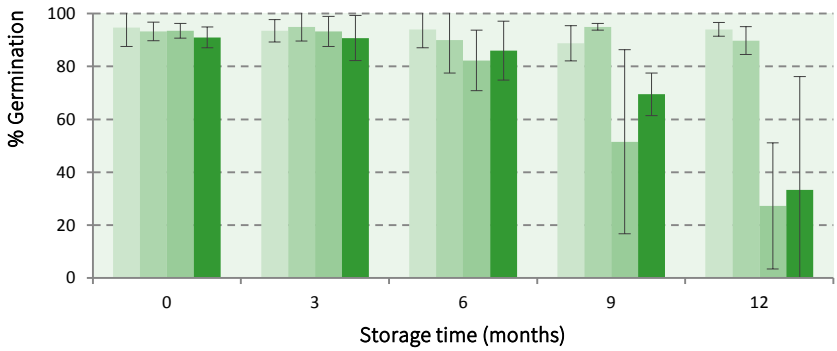
Impact on maize weevils population growth in stored maize



Impact on maize grain damage over storage period



Impact on maize seed viability over storage period



A field trial was carried out in Lusaka area, where 50 kg ZeroFly® Storage Bags were compared with locally procured untreated polypropylene (PP) bags with or without insecticidal treatment of grain (normal practice: Shumba® = Fenitrothion 1% & Deltamethrin 0.13%). The study duration was 12 months in a purpose built research-facility, simulating a commercial warehouse, with natural and additional artificial infestation of maize weevils and larger grain borers.

There were highly significant differences ($P < 0.001$) in weight loss, grain damage, number of live larger grain borers (*Prostephanus truncatus*) and maize weevils (*Sitophilus zeamais*) between the untreated controls and the insecticidal treatments over time. Significantly higher ($P < 0.001$) seed viability was recorded for seed obtained from insecticidal treatments, when compared with seed from untreated control bags.

Deltamethrin residues on grain stored within ZeroFly® Storage Bags remained below MRLs during the storage period of 1 year.

Laboratory bioefficacy tests confirmed 100% mortality for both maize weevils and larger grain borers when exposed to samples collected from ZeroFly® Storage Bags over the 1 year period.

The study showed that ZeroFly® Storage Bags effectively in controlled maize weevil & larger grain borer infestation in the warehouse. Effective protection against storage pests, maintaining grain quality & damage levels below 1.5% over the 1 year storage period was provided.
High seed viability for maize stored for 1 year was preserved and ZeroFly® Storage Bags remained highly effective, killing insects even after 1 year of field use.

Research Evidence: Field

Ethiopia: Bako Agricultural Research Center, Bako

Treatment	% Dead Maize weevils	% Dead Angoumois grain moths	% Damaged kernels	% Germination
ZeroFly® Storage Bags	88[a]	100[a]	1.3[b]	89[a]
Aluminum phosphide	92[a]	100[a]	1.1[b]	87[a]
Malathion (5% a.i.*)	87[a]	81[b]	1.8[b]	84[a]
Untreated PP bags	32[b]	54[c]	7.7[a]	84[a]

Results with different letters represent statistically significant differences between treatments (P<0.05)
*active ingredient

The study showed that ZeroFly® Storage Bags were as effective as fumigation and insecticidal dust treatments. ZeroFly® Storage Bags controlled maize weevils & Angoumois grain moths in maize storage for over 6 months.

ZeroFly® Storage Bags were compared to local practices over 6 months of storage. The treatments were as follows:

- Polypropylene (PP) bags, with no pest control measures
- Polypropylene (PP) bags & fumigation with Aluminium phosphide
- Polypropylene (PP) bags & Malathion (5% a.i.) mixed with the grains

The study was carried out in a grain storage facility with natural infestation of storage pest insects.

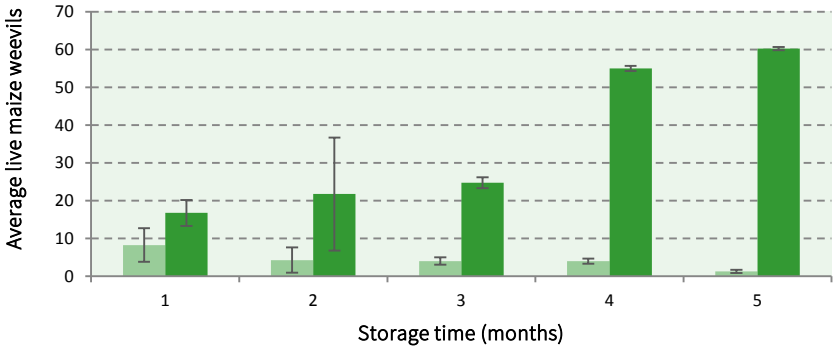
After 6 months storage, all insecticidal treatments were effective against the storage pests tested. With ZeroFly® Storage Bags 100% mortality was recorded for Angoumois grain moth (*Sitotroga cerealella*) and 87% for maize weevils (*Sitophilus zeamais*) adults, additionaly the germination remained above 89%.

Results of the insecticidal treatments were not significantly different, all performing significantly better than the untreated control.

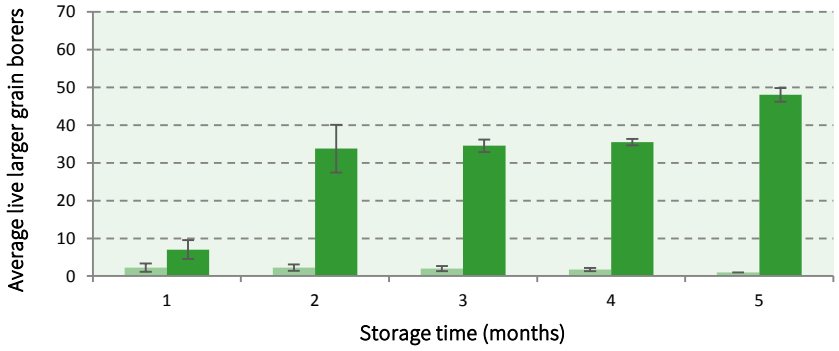
Research Evidence: Field

Ghana: African Regional Postgraduate Program in Insect Science Laboratory, University of Accra

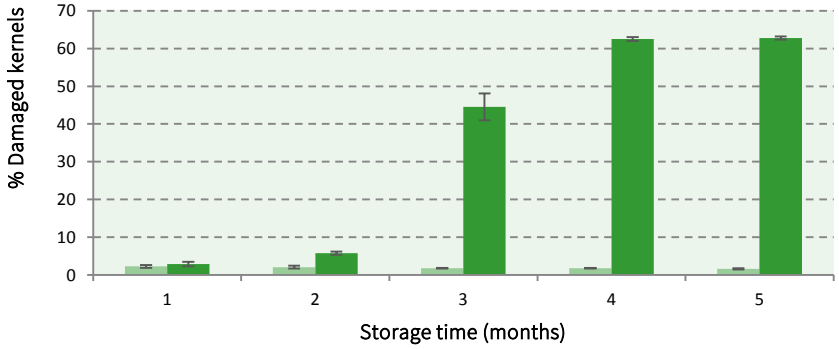
Impact on maize weevil population growth in stored maize



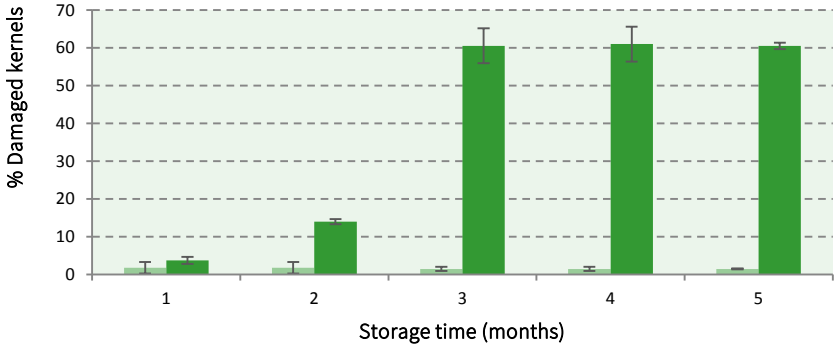
Impact on larger grain borer population growth in stored maize



Impact on grain damage by maize weevils over storage period



Impact on grain damage by larger grain borers over storage period



ZeroFly® Storage Bags
Control (untreated PP bags)

In a field trial in Accra, 50 kg ZeroFly® Storage Bags were compared to locally procured untreated polypropylene (PP) bags (negative control) over 6 months of storage.

Untreated maize was frozen to kill any insect infestation coming from the field, pre-bagging. Each bag was then artificially infested with 20 adults of larger grain borer (*Prostephanus truncatus*) or maize weevil (*Sitophilus zeamais*) and placed into storage for 6 months.

The control bags had significantly higher ($P < 0.05$) numbers of live insects after the period of study for both pests.

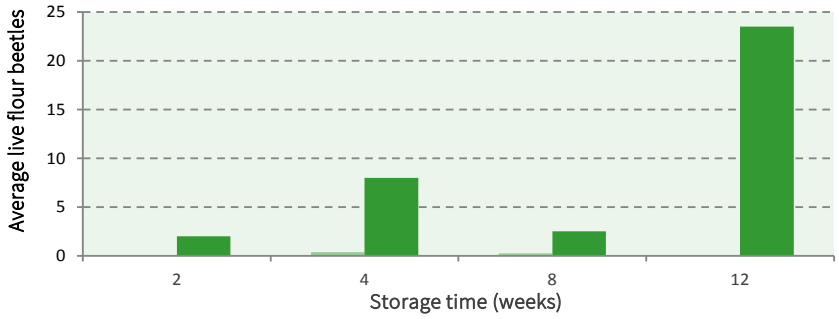
The grain kept in the untreated control bags had significantly higher ($P < 0.05$) damage than those kept in ZeroFly® Storage Bags for both insect species. Damage were comparable for both storage pests, which was greater than 60% after 6

The study showed that ZeroFly® Storage Bags were effective in controlling maize weevils & larger grain borers. Grain damage was maintained at a low level (below 3%) throughout the 6 month trial period.

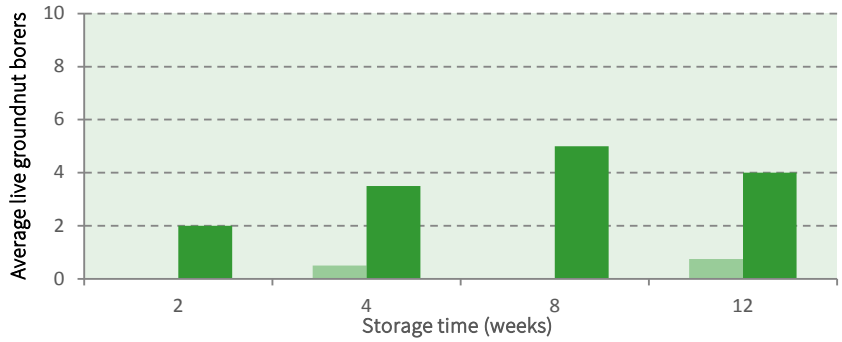
Research Evidence: Field

Senegal: Interdisciplinary Team for Phytosanitary Experiments of Ministry of Agriculture, Dakar

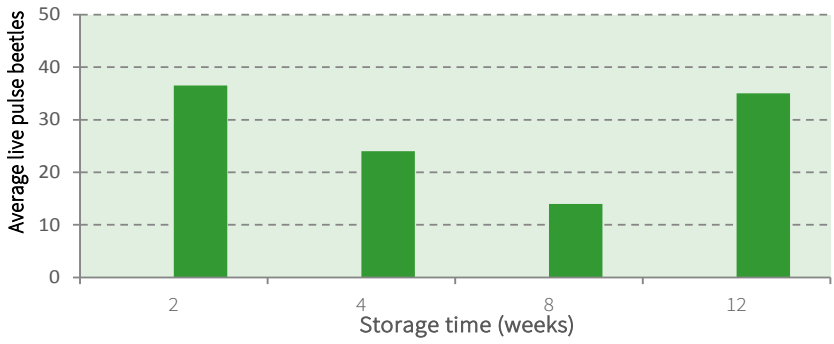
Impact on flour beetle population growth in millet over storage period



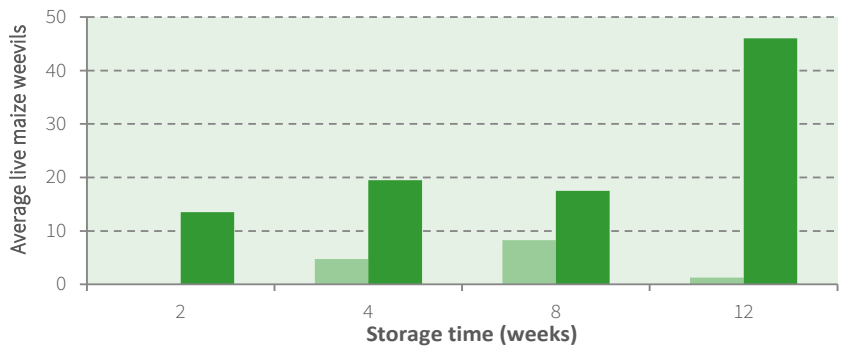
Impact on groundnut borer population growth in groundnuts over storage period



Impact on pulse beetle population growth in cowpeas over storage period



Impact on maize weevil population growth in maize over storage period



ZeroFly® Storage Bags
Control (untreated PP bags)

In a field trial near Dakar, the efficacy of 50 kg ZeroFly® Storage Bags to protect crops of local importance (groundnuts, cowpeas, maize and millet) was assessed against key target pest species over 3 months, under normal commercial warehouse conditions.

The commoditites were frozen to kill any insect infestation from the field, then bagged, using either ZeroFly® Storage Bags or locally procured polypropylene (PP) bags and randomly assigned across the warehouse.

All untreated control bags had significantly higher ($P < 0.05$) numbers of live insects over the storage period, for all the commodities within the trial.

Insect counts in the storage area showed a significantly higher number of dead insects (a total of 15'535 dead vs. 2308 live) providing a strong indication of "community protection" of ZeroFly® Storage Bags in the warehouse setting.

ZeroFly® Storage Bags effectively killed groundnut borers, pulse beetles, maize weevils and flour beetles. ZeroFly® Storage Bag provided protection for groundnuts, cowpeas, maize and millet stored for 12 weeks, providing a barrier to insects trying to penetrate the bags and so reducing the overall warehouse insect population.

Usage Guidelines

Step 1

Dry harvested or milled grains to moisture levels safe for storage (<14% for grains & <12% for seeds).

Step 2

Ensure the grain is insect-free (solarization, fumigation, etc.) & the grains are mold-free prior to bagging.

Step 3

Pour the grain into ZeroFly® Storage Bags as soon as possible to ensure no insect infestation.

Step 4

Seal the bags by sewing or tying immediately after bagging. Ensure that the bags are tightly closed after each opening to prevent insect entry.

Handling & Safety Information

- Do not use hooks while lifting or carrying the bag.
- Do not expose the bag to extreme heat, direct sunlight &/or open flame.
- Occasionally (quarterly) brush fabric to prevent dust/ dirt build-up on exposed surfaces.
- Use gloves and cover exposed body parts with appropriate clothing while lifting or carrying the bag.
- Wash hands with soap & water after handling the bag.
- Dispose of the bag after its intended use as per local regulatory guidelines.

Frequently Asked Questions

How does ZeroFly® Storage Bag work?
ZeroFly® Storage Bag works by establishing a long-lasting insecticidal protection around the bagged commodities. When the pests come into contact with the bag in an attempt to reach the stored commodities, they get a lethal dose of insecticide and are killed.
ZeroFly® Storage Bags are similar in usage to any other polypropylene storage bags, with the additional benefit of insecticidal killing action.

What insecticide is used and how safe is it?
The insecticide active ingredient is deltamethrin, a pyrethroid. Deltamethrin is approved by FAO for use in agriculture and by WHO for use in public health. This product is considered safe for farmers and consumers. Maximum Residue Limits assessments reveal that levels of insecticide on the stored commodities are below the most stringent standards globally.

What pests does it control?
ZeroFly® Storage Bags will control deltamethrin susceptible insects when they contact the bags. Tests have confirmed control of all major post-harvest insect pests, including; weevils, borers, and moths.

What is the lifespan of ZeroFly® Storage Bag ?
ZeroFly® Storage Bag will remain effective for 2 years depending upon environmental conditions where the bag is used.

What is ZeroFly® Storage Bag made of and why was this material chosen?
ZeroFly® Storage Bag is made of a polypropylene polymer that has the insecticide incorporated into the yarns. The material was chosen for its properties of controlled and sustained release of the insecticide for the life of the product and since the textile is durable enough for its intended use.

What colors does it come in?
As standard, white, with ZeroFly® printed logo. It can also come in a variety of colors and printed central logos upon request.

What research has been done to show that it is effective?
ZeroFly® Storage Bag has been studied in laboratory studies to show efficacy against insects. It has also been evaluated in accelerated storage conditions as well as real usage in field studies to confirm action against field populations of various key storage pests.

Are bags safe to stack in warehouses?
The ZeroFly® Storage Bags provide an extra level of safety in the warehouses as they have an antislip weave pattern to reduce slippage.

How is the storage bag maintained?
The ZeroFly® Storage Bag is intented for indoor storage of commodities. The material should be kept clean by occasionally using a soft broom to avoid build up of dust on the surface. Keeping dirt and dust off the material is important to prevent any interference between the insecticide on the surface and its contact with the storage pest insects, ensuring maximal efficacy.

Can it be safely discarded?
At the end of its intended lifetime or if physical integrity is lost, ZeroFly® Storage Bag can be disposed of as per local guidelines, for example following regulations for disposal of plastic waste, as fuel for brick kilns, or alternatively, recycled into products that have limited human contact such as waste pipes.

Vestergaard

Vestergaard is a global company committed to improving lives of people in developing countries with important food security interventions. Vestergaard believes strongly in humanitarian responsibility and the commitment to the United Nation's Millennium Development Goals drives business objectives and provides the impetus for continued focus on innovation.

With extensive Research & Development, Vestergaard is dedicated to improve and support the health of the most vulnerable people on earth by continuously improving our products. We encourage the independent evaluation of our products at recognized international research institutions.

ZeroFly® Storage Bags are produced in ISO 9001 certified manufacturing facilites. The active incredient used in the product, deltamethrin, is only sourced from suppliers approved by FAO/WHO.

The product is tested in ISO IEC 17025 accredited Vestergaard laboratories before release with a Certificate of Quality or Certificate of Analysis.

Any customer inquiry on product performance or quality is promptly addressed. We provide a testing service to verify quality of our products for customers.

For more information, visit
www.vestergaard.com

Our life-saving tools include:

ZeroFly® Storage Bags
Insectide-incorporated storage bags protecting crops and seeds

ZeroFly® Screen
Insectide-incorporated screen protecting livestock from flies

ZeroFly® Targets & Traps
Tools to monitor and control tsetse and biting fly populations

LifeStraw®
Water filters reducing diarrheal diseases

PermaNet®
#1 long-lasting insecticidal nets

Impacting People

ZeroFly® products aim to end hunger through reduced losses and increased productivity

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