

A large yellow grain auger is shown pouring a thick stream of grain into a blue trailer. The scene is set against a golden sunset sky, with the grain creating a misty atmosphere. The background shows a vast field of grain under the warm light of the setting sun.

Guide to on-farm grain preservation

Steps for success

EASTMAN

Contents

Section 1: Mold growth in feeds

1.1 Typical mold strains	6
1.2 Molding caused by moisture migration and condensation	7
1.3 Potential direct and indirect losses	8

Section 2: Aerobic grain preservation

2.1 Products for aerobic grain preservation	10
Eastman Propcorn NC for versatile preservation purposes	12
Eastman Propcorn Plus for the most demanding mold control needs	13
Efficacy and application recommendations demonstrated by research	14
2.2 Fundamentals for aerobic grain preservation	18
Recommendations for applications	18
Risk factors	19
Screw conveyor characteristics	20
Acid applicator characteristics	21
Care of the machinery	21
Aerobic preservation of crushed grains	22
Storage	22
Additional factors to consider	23
2.3 Recommended application rates for aerobic preservation	24
Unbroken whole grain	24
Crushed or rolled grains	24
Peas, beans, lupin, and rapeseed	25
Moist whole grain with preservation time up to 6 months	25

Section 3: Crimping and ensiling high-moisture grains

3.1 Products for grain crimping	26
3.2 Recommended application rates for grain crimping	28
3.3 Tips for successful crimping and ensiling	29

Section 4: Improving stability of total mixed ration (TMR)

4.1 Products for TMR stabilization	30
Eastman Stabilizer TMR for improving stability	31
4.2 Recommended application rates for TMR	32

Section 5: Other on-farm preservation

5.1 Improving haylage quality	34
5.2 Extending the shelf life of brewer's grains	35

Section 6: Organic acids

6.1 Combine efficacy with safety	36
6.2 Organic acids are naturally present in living cells.	36
6.3 Product recommendations	37

Protect your investments.

You've put in the hard work—sowing the seeds, maintaining your crops, and dealing with the weather and the many other challenges of farming. After all this effort, your crops are ready for harvest. Why take unnecessary risks?

Eastman Animal Nutrition offers a wide portfolio of proven solutions for your on-farm preservation needs. Clean, high-quality feed supports animal health and welfare, increases yields, and allows for efficient farm management, letting you focus on the things that create value for your farm.

Together, let's make sure you get the best return on your investments.



1.1 Typical mold strains

Molds are opportunistic and capable of growing in extreme conditions. They don't need much moisture or oxygen. Whenever there is condensation and some oxygen, mold spores—which are ubiquitous—can grow.

In freshly harvested grain, moisture content varies and is often high enough for harmful microbes to thrive. Molds may grow on grains when the moisture is above 14%. When moisture is above 25%, spontaneous heating due to microbial activity can occur less than 24 hours after harvesting. To avoid spoilage, grains need to be protected as soon as possible.

Table 1. Occurrence and effects of certain storage molds and their toxins

Storage mold species	Raw material	Mycotoxin	Toxic effects
<i>Aspergillus ochraceus</i> <i>Penicillium verrucosum</i>	Grain	Ochratoxin A (OTA)	<ul style="list-style-type: none"> • Reduced feed intake • Kidney damage • Low egg production • Thin egg shells^{1,2}
<i>Aspergillus flavus</i> <i>Aspergillus parasiticus</i>	Maize, herbs, oil-containing seeds	Aflatoxin B ₁ , B ₂ , G ₁ , G ₂	<ul style="list-style-type: none"> • Reduced appetite • Immunosuppression • Liver lesions/hepatosis • Feather loss³
<i>Penicillium roqueforti</i>	Grain, maize	Roquefortine C	<ul style="list-style-type: none"> • Extensive paralysis⁴
<i>Aspergillus flavus</i> <i>Penicillium cyclopium</i> <i>Aspergillus versicolor</i>	Maize, wheat	Cyclopiazonic acid	<ul style="list-style-type: none"> • Diarrhea, ulcers, and enteritis⁵
<i>Penicillium citrinum</i>	Barley, maize	Citrinin	<ul style="list-style-type: none"> • Kidney damage⁶

¹<https://www.hindawi.com/journals/jeph/2012/835059/>

²<https://www.ncbi.nlm.nih.gov/pubmed/17447842>

³<https://www.mdpi.com/2077-0472/15/3/742>

⁴<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4549740/>

⁵<https://www.ncbi.nlm.nih.gov/pubmed/16464302>

⁶<https://www.ncbi.nlm.nih.gov/pubmed/20020900>

1.2 Molding caused by moisture migration and condensation



Close attention must be paid to potential moisture migration and condensation in grain storage. Moisture migration may take place when air is transporting moisture. As air temperature drops, extra moisture condenses and makes grain moist, enabling mold growth. To reduce risks related to moisture migration and condensation, use Eastman Propcorn products according to application instructions and monitor grain temperature in the storage.

Figure 1. Moisture migration via normal air convection in drying

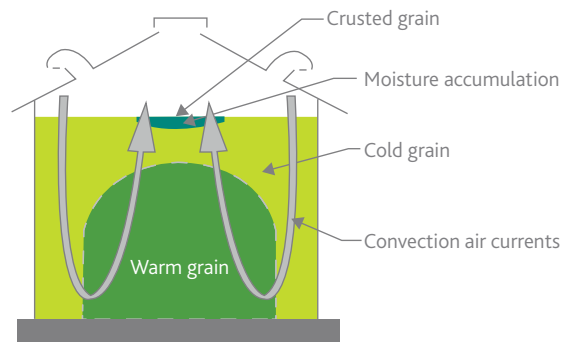
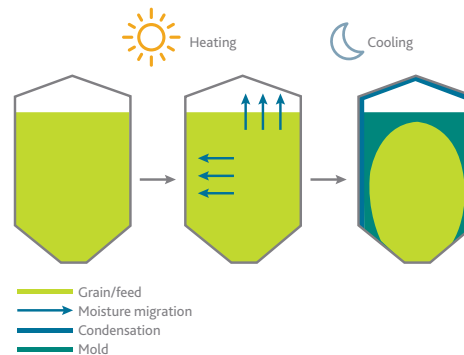


Figure 2. Effect of the daily temperature difference



1.3 Potential direct and indirect losses

It is generally recognized that mold spores in feed can lead to growth that consumes valuable nutrients. Spoiling microbes include bacteria, yeasts, and molds, which need to be controlled from harvest to feeding. Feed moisture content, oxygen availability, temperature, and feed pH are the major environmental factors influencing microbial challenges and how quickly spoilage will take place. Bacteria and yeasts typically need more moisture for their growth than molds. When grain moisture is below 30%, preventing molds is the main concern during preservation.

Direct losses from a failure in preservation may just be the tip of the iceberg, and many indirect consequences of molds are not as easily detectable. Molds have the potential to produce mycotoxins, which can adversely impact animals' long- and short-term health and fertility. Consumption of molded feed can lead to a compromised immune system, making the animals more vulnerable to diseases. Impaired animal health may not be detected until sometime after initial exposure, blurring the linkage between mold growth and animal well-being. This is why it is important to always ensure that animals do not consume moldy feed. The long-term losses can be far greater than the value of the grain.

Molds are also a hazard for workers. Exposure to dust from moldy feed can result in a serious respiratory condition generally known as "farmer's lung." Humid harvesting conditions increase this risk, underlining the importance of proper mold control. Furthermore, the effort required to manage moldy feeds causes extra strain on the workers. Separating spoiled grain and caring for sick animals diverts attention from other responsibilities and can cause additional stress to farm management.

It is worthwhile to invest in the well-being of animals as well as workers. Good hygienic-quality feed is free of pathogens, contains only a low number of spoiling microbes, and supports animal health and welfare. Healthy animals can fully achieve their production potential and minimize veterinary costs.

Figure 3. Potential direct and indirect losses due to mold growth



2.1 Products for aerobic grain preservation

Propionic acid provides a strong, effective antifungal effect and has been used in feed and food preservation for decades. However, pure propionic acid is corrosive to both skin and metal, requiring special materials for equipment. Furthermore, its volatility causes a pungent odor.

Through experience and years of extensive research, Eastman is able to demonstrate that buffering propionic acid with ammonium propionate reduces its volatility and corrosivity. Buffering reduces the product smell and makes it less corrosive to both skin and metal when compared to pure propionic acid. Therefore, Eastman Propcorn products are safer to use and provide the effectiveness of propionic acid against molds with ingredients naturally present in the animals' digestive system.

Propcorn Plus and Propcorn NC have been especially developed as more user-friendly alternatives to propionic acid for grain preservation. Propcorn products are particularly suitable for on-farm usage to control molds as well other harmful microbes that may proliferate in feeds together with molds.

Figure 4. Choose the right solution based on moisture percentage of the grain.

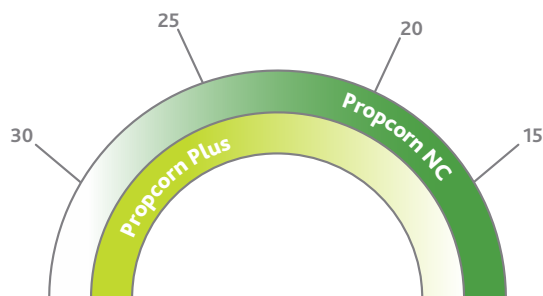


Figure 5. Propcorn products show reduced metal corrosivity and lower volatility compared to propionic acid.

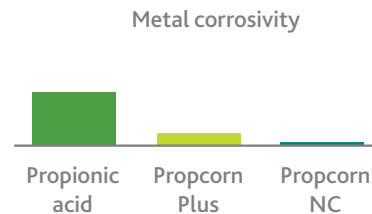


Figure 6. Low vapor pressure correlates to reduced odor of Propcorn products.

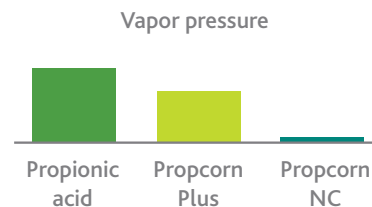
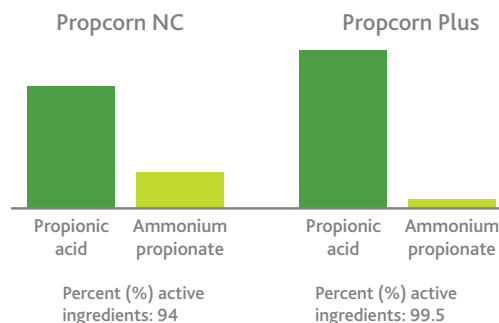


Figure 7. Propcorn products have a high percentage of active ingredients.



Eastman Propcorn NC for versatile preservation purposes

Eastman Propcorn NC is a noncorrosive, multipurpose product for on-farm preservation use where efficacy must be combined with convenience of use. Its milder smell is among the features that make Propcorn NC beneficial for farm use compared to propionic acid.

Propcorn NC is an excellent choice for most aerobic grain preservation. The product is well suited for preventing mold growth in hay, straw, and ensiled crimped grain or ensiled high-moisture corn and legumes. It is also suitable for silage surface treatment. Feeds preserved with Propcorn NC maintain their nutritional value and natural color with minimal dusting when handled. When molds are controlled using Propcorn NC, other harmful microbes such as yeast and bacteria will also be reduced.

Propcorn NC is a balanced formulation of propionic acid with ammonium propionate, which gives the product a mild odor and lower volatility while substantially reducing corrosivity to skin or metal. Propcorn NC has been demonstrated as noncorrosive to stainless steel and aluminum. The product is only a moderate irritant to skin based on OECD 404 Test Guideline. Therefore, Propcorn NC is safer to handle and can be transported as non-ADR.

Propcorn NC is labeled as a complementary feed, following the EU feed legislation. The product provides a nitrogen source for rumen microbes, and the crude protein concentration is 20.5%. An additional benefit is that the components of the product are glucogenic energy sources for ruminants.

Active ingredients: propionic acid and ammonium propionate

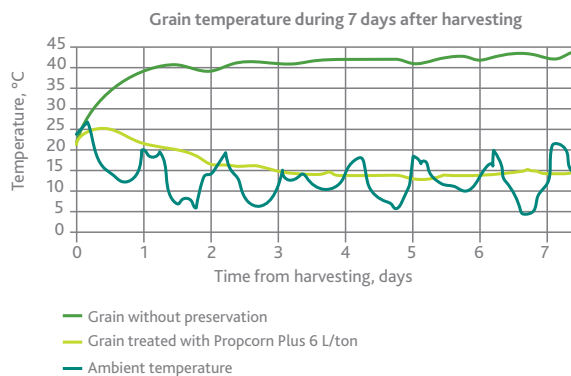
Eastman Propcorn Plus for the most demanding mold control needs

With Eastman Propcorn Plus, whole grain, crimped grain, or high-moisture corn can be preserved cost-effectively. It is a less buffered blend of propionic acid and ammonium propionate than Propcorn NC. Propcorn Plus is suitable for the most demanding mold-control needs, such as aerobic grain preservation when grain moisture level is above 25%.

Propcorn Plus-treated grain has been proven to show substantially lower temperature in a trial where it was used immediately after harvesting high-moisture grain to delay mold growth.

Active ingredients: propionic acid and ammonium propionate

Figure 8. Eastman Propcorn effectively prevented grain from spoiling.



Source: Luke, Natural Resources Institute Finland, 2019



Efficacy and application recommendations demonstrated in research

Correct and reliable application instructions are crucial to successful preservation. Therefore, research trials are valuable because several replicates per treatment can be evaluated and different preservatives can be compared with each other under the same controlled conditions. Recommendations for Eastman products are based on scientific trials as well as practical experiences at the farm level. In grain preservation, application instructions are very detailed due to the variety of different combinations of grain species, grain moisture, grain crushing, and preservation time.

In a trial conducted by Natural Resources Institute Finland (Luke), high-moisture wheat was preserved using Eastman Propcorn products.

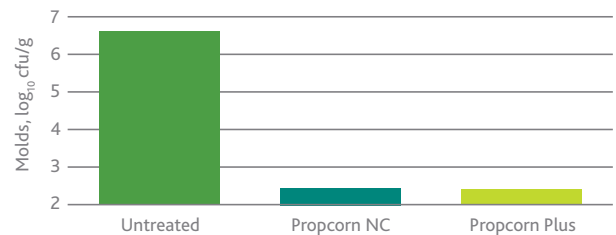
- Grain was harvested in four different moisture levels and treated with Propcorn Plus or Propcorn NC.
- Control treatments without preservative were also included.
- Three replicate treatments were done with replicate size of 20 kg.
- Temperature of the grains were followed to detect any start of spoilage.
- After 7 months, grain batches were turned around to confirm the outcome and take samples.

Substantial differences in quality were visually detectable.

Grain preservation results were ideal when Propcorn products were applied according to instructions. All untreated grains spoiled with significant, visible mold growth. Results confirm the reliability of Propcorn when proper application instructions are followed.

Grain without preservative was molded and dusty, while grains treated with Propcorn NC and Propcorn Plus appeared perfectly preserved without dust or any visual signs of molds.

Figure 9. Mold counts in grain samples



Propcorn-treated grains show excellent quality.



All untreated grains spoiled.



Propcorn-treated grains did not heat.

Eastman Propcorn NC and Propcorn Plus-treated grains did not show any significant temperature increase during the 6-month period when application level recommendations were followed. When inspected, excellent grain quality was confirmed.

Figure 10. Temperature of Propcorn NC-treated grains

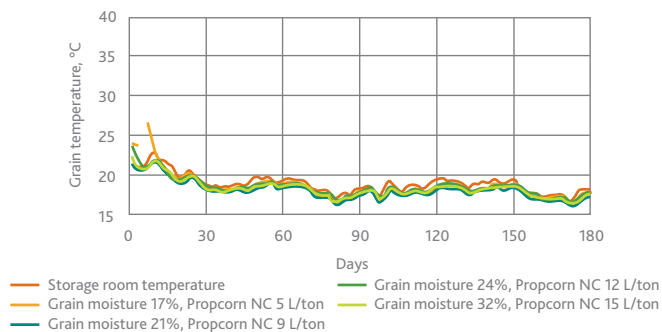
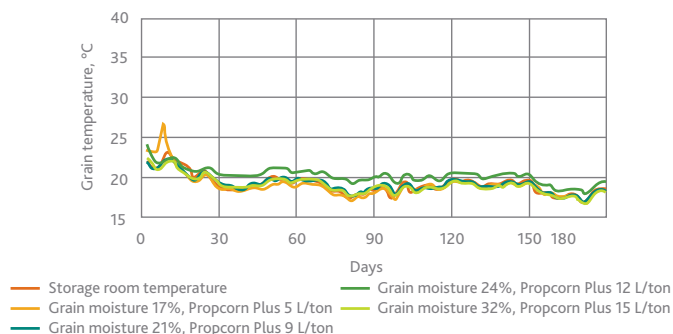


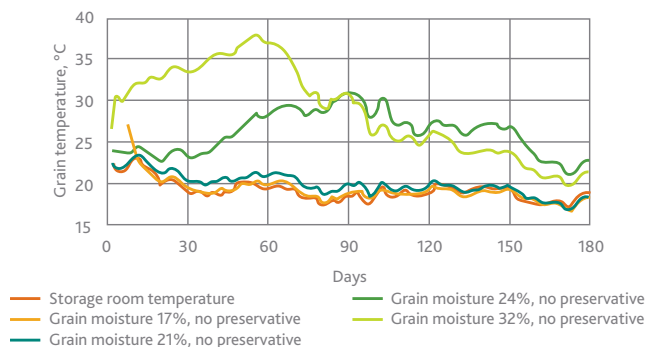
Figure 11. Temperature of Propcorn Plus-treated grains



Rapid heating was detected in high-moisture untreated grains.

All the untreated grains were spoiled within the follow-up period. Grains with moisture of 32% or 24% spoiled rapidly, resulting in a substantial temperature increase within the 20-kg grain sample. Grains with moisture of 21% or 17% spoiled slower, and only some heat was detected.

Figure 12. Temperature of untreated grains



Propcorn treated grains,
moisture 21%



Untreated grains,
moisture 21%



2.2 Fundamentals for aerobic grain preservation

Recommendations for application

- Always treat the grain on the same day it is harvested, and minimize the delay between harvesting and preservative application.
- Use the right application level; the grain moisture level and preservation time determine how much preservative is needed to prevent the growth of molds. The higher the moisture, the more preservative is needed.
- A device to detect the moisture level of grains is a must. Remember to calibrate the device to obtain the best results.
- Check the moisture from each load. Pay special attention to any areas that show higher moisture levels. Adjust the application level to be sufficient for treating the highest detected moisture level.
- Spray the preservative via nozzles into a screw conveyor with special applicator for acids. The goal is to treat each individual kernel with preservative.

Things to avoid

- Eastman Procorn products should not be diluted when used for grain preservation, because any additional water will reduce efficacy.
- To avoid losses into the air, do not inject preservative directly into the grain conveyor blower. High wind may also increase losses if preservative is sprayed into an open container.

Risk factors

For effective preservation

- High ambient temperature
- High moisture in the feed
- Long preservation time
- High initial number of spoiling microbes
- Crushing of grains
- High protein seeds

For preservative application

- Variable grain moisture—it's important to detect the highest moisture level within the batch.
- Airflow through the grain during storage may move the moisture. Monitor the grain temperature.
- Temperature during treatment affects preservative viscosity. Monitor preservative consumption carefully during spraying.
- Any interruptions to additive spraying pose a risk.
- If a grain blower is used to convey the grains, intermediate storage of one hour is necessary to minimize losses. Furthermore, application should be increased by at least 10% to cover potential propionic acid evaporation.
- If the grain temperature is above 35°C, increase application rate by 10%. High temperature may increase losses due to evaporation.



Screw conveyor characteristics

- Minimum length: 3 m
- Number of nozzles depends on the screw conveyor diameter:
 - < 180 mm → 3 nozzles
 - 180–200 mm → 4 nozzles
- Nozzles should be mounted at a spacing of 1.5 windings.
- Screw conveyor should stay at a minimum of a 30 degree angle to enable proper mixing.
- Operate the screw conveyor at 60%–70% of the maximum rate for loose mixing of the grain.
- Measure the grain conveying rate of the screw conveyor by weighing the grains that pass through the conveyor in a known time span. Grain properties affect the speed, so it's important to measure the actual speed with the grains that are going to be treated with preservative.

Acid applicator characteristics

- Check the acid applicator performance before each season. The capacity of the entire setup, including the nozzles, should be gauged with water before the start of each season. However, it's worth remembering that Procorn products have slightly higher viscosity and density than water.
- Measure the real consumption with the preservative itself for proper calibration. If there is uncertainty in the expected flow rates, adjust the pump until the right level is found. Consider that it's safer to overdose than underdose. Underdosing should be absolutely avoided, because any underdosed spot may lead the entire silo or batch to molding.
- Always start the acid applicator first and then the screw conveyor to make sure that no untreated grain reaches the store.

Care of the machinery

- After treatment, the screw conveyor should be cleaned by conveying dry, untreated grain through the conveyor. Do not store this untreated grain with treated grains.
- To clean the machinery further, pH-neutralizing products made for corrosion prevention are available. If pure water is used for cleaning, enough water should be used to remove any preservative residue.
- After cleaning, the equipment should be dried as quickly as possible, since water enables corrosion.



Aerobic preservation of crushed grains

- Higher application level of preservative is needed for crushed grains compared to whole grains. Breaking the seed coating of the grains gives microbes easy access to their nutrient stores, and crushing substantially increases the surface area to be treated.
- Be aware that the conveyor of the crimping machine is typically not long enough to ensure even application for aerobic grain preservation. In such case, preservative application should be conducted using a separate screw conveyor equipped with appropriate number of nozzles for acid treatment. All detailed application instructions for aerobic grain preservation need to be carefully followed.

Storage

- Suitable storage methods for Eastman Propcorn preserved grains include:
 - Free heaps in halls; concrete floor protected with plastic film
 - Wooden boxes or tower silos covered with roof
 - Tower silos with acid-resistant inside coating
 - Concrete silos with acid-resistant coating

Follow grain temperature in storage monitoring daily for the first 3 weeks. Thereafter, check temperature once a week. A temperature increase of 4°C or more indicates inadequate application or poor mixing. In this case, repeat the treatment with Eastman Propcorn to stop the spoiling process.

Additional factors to consider

- Stored grain should be protected from any additional water, including condensation.
- Grain shouldn't be covered with plastic sheeting, since moisture may condense below the sheeting and cause spoilage of the top layer of the grains.
- Treated, moist grain shouldn't be stored together with dry, untreated grain, since the moisture will migrate from moist grain into the dry grain, causing it to spoil.
- When grain is treated with Propcorn, aeration is not recommended because it may cause volatilization of propionic acid. In addition, aeration may transport moisture within the grain batch.
- If heating (more than 4°C) is detected, it's recommended to re-treat the batch.



2.3 Recommended application rates for aerobic preservation

Unbroken whole grain

Eastman Propcorn NC (L/ton)				
Grain moisture (%)	Preservation period (months)			
	1	1-3	3-6	6-12
Up to 16	3.9	4.5	5.1	6.8
16-18	4.5	5.1	5.8	8.0
18-20	5.2	7.0	8.0	9.5
20-22	6.0	8.5	9.5	10.5
22-24	7.5	10.0	11.0	12.0
24-26	9.0	11.5	12.5	13.5
26-28	10.0	12.2	13.9	15.0
28-30	12.5	15.0	16.0	17.0

Crushed or rolled grains

Eastman Propcorn NC (L/ton)				
Grain moisture (%)	Preservation period (months)			
	1	1-3	3-6	6-12
Up to 16	4.4	5.5	6.1	7.8
16-18	5.0	6.4	7.1	9.3
18-20	5.9	8.3	9.3	10.8
20-22	6.7	9.8	10.9	12.0
22-24	8.2	11.3	12.4	13.5
24-26	10.0	12.8	13.9	15.0
26-28	11.5	13.7	15.4	16.5

Peas, beans, lupin, and rapeseed

Eastman Propcorn NC (L/ton)				
Grain moisture (%)	Preservation period (months)			
	1	1-3	3-6	6-12
Up to 12	3.8	4.8	5.8	6.3
12-14	4.8	5.8	6.3	7.7
14-16	5.3	6.3	7.1	8.8
16-18	5.9	7.1	7.8	10.0
18-20	6.6	9.0	10.0	11.5
20-22	8.0	11.5	12.5	13.5

Eastman Propcorn Plus for moist whole grain

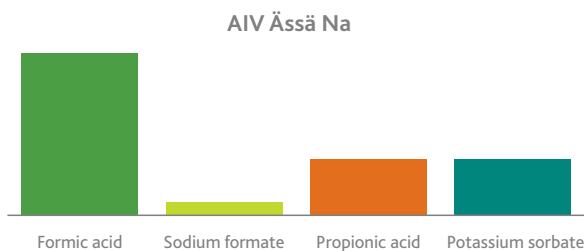
Eastman Propcorn Plus with preservation time up to 6 months	
Grain moisture (%)	L/ton
< 16	6.0
16-18	6.5
18-20	7.5
20-22	9.0
22-24	10.5
24-26	12.0
26-28	13.5
28-30	15.0

Increase application by 1.0-1.5 L/ton if preservation time is longer than 6 months or if the grain is crushed prior to preservation.

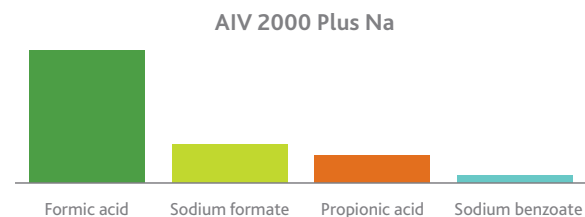
3.1 Products for grain crimping

High-moisture grains can be crimped, treated with acid additive, and then ensiled airtight. This method allows you to control microbes by eliminating oxygen and reducing pH. Organic acids help to control microbes both during the ensiling period and during feed-out. Rapid reduction in pH, together with the antimicrobial effect, helps minimize losses and ensure high palatability of the grains.

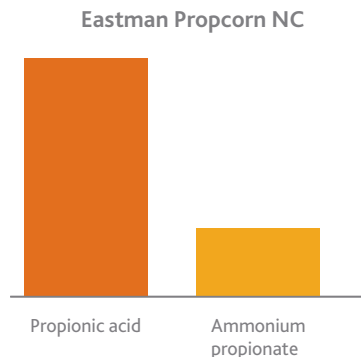
Figure 13. Product characteristics and recommendations for different crimped grain moistures



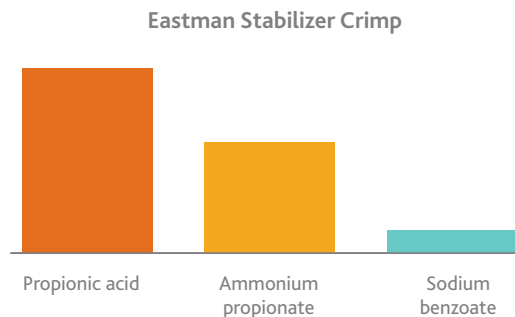
- For grains having moisture above 25%
- Provides rapid drop of pH
- Controls bacteria, yeast, and molds
- Versatile composition enables broad control over spoiling microbes
- Improves stability after silo opening
- Slightly buffered
- 86% active ingredients



- For grains with moisture above 30%
- Provides rapid drop of pH
- Controls bacteria and yeasts
- Improves stability after silo opening
- Buffered for reduced metal corrosivity and milder smell
- 76% active ingredients



- For grains with moisture less than 30%
- Controls yeast and molds
- Improves stability after silo opening
- Buffered for reduced metal corrosivity and milder smell
- Not classified as dangerous in transport (non-ADR)
- 94% active ingredients

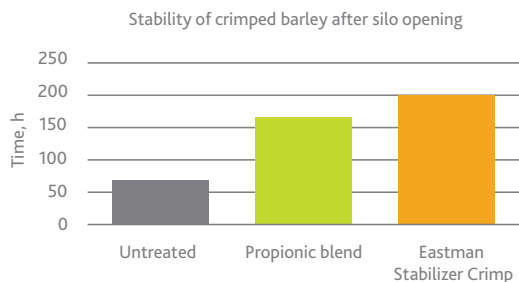


- For grains having moisture less than 30%
- Versatile composition enables broad control over yeast and molds
- Buffered for reduced metal corrosivity and milder smell
- Not classified as dangerous in transport (non-ADR)
- Mild odor
- Classified as skin irritant only
- 90% active ingredients

3.2 Recommended application rates for grain crimping

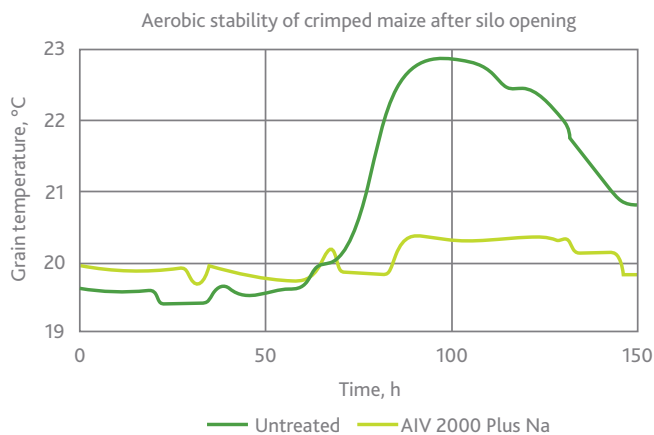
Product application level is 3–5 L/ton of grain. The higher rate is recommended for low-moisture grains due to higher aerobic challenge caused by grain porosity. Increase application by 1 L/ton for peas and beans.

Figure 14. Eastman Stabilizer Crimp is an excellent choice for low-moisture (<30%) crimping to improve grain stability.



Source: Silage Solutions, UK, 2016

Figure 15. AIV 2000 Plus Na is well suited for grain crimping when grain moisture is above 30%.

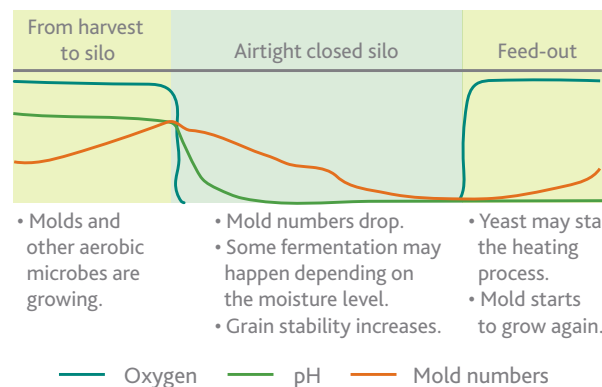


Source: Rostock University, 2015

3.3 Tips for successful crimping and ensiling

- Act fast. Minimize time between harvest and ensiling.
- Select acid additive and adjust application to level suitable for grain moisture.
- Measure grain moisture using a calibrated device.
- Ensure correct application rate and even distribution of additive.
- Compact silo and cover it airtight.
- Keep bunker silo closed, preferably for two months. Silo bags can be opened sooner.
- Ensure high enough grain consumption rate after silo opening.

Figure 16. Crimping process includes both aerobic and anaerobic phases



- Molds and other aerobic microbes are growing.
- Mold numbers drop.
- Some fermentation may happen depending on the moisture level.
- Grain stability increases.
- Yeast may start the heating process.
- Mold starts to grow again.

— Oxygen — pH — Mold numbers

4.1 Products for TMR stabilization

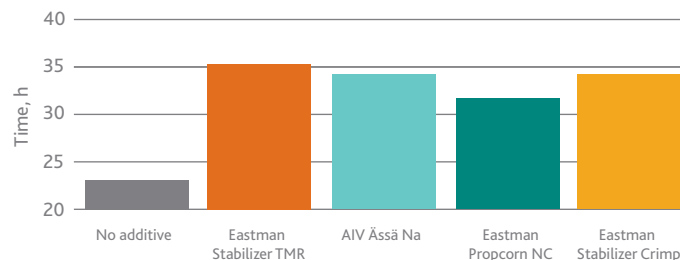
Total mixed ration (TMR) can be a suitable environment for the growth of several microorganisms that cause spoilage. The rapid growth of these microbes consumes nutrients in TMR and causes spontaneous heating. This may result in reduced feed intake, reduced milking frequency in automated milking, and decreased milk production. To avoid this, an easy approach is to use organic acid-based additives to control the spoilage.

Propcorn NC and Stabilizer Crimp are good choices for stabilizing TMR when focus is fungal species. They contain plenty of propionic acid, which additionally provides glucogenic energy for ruminants. When TMR includes wet silages or added water, Eastman Stabilizer TMR or AIV Ässä Na are good choices for TMR stabilizing.

Figure 17. Eastman product features for TMR

	Not classified as dangerous in transport (non-ADR)	High energy value due to plenty of propionic acid	Synergies of several organic acids to control spoiling microbes	
			Combination of formic and propionic acid	Contains sodium benzoate
Eastman Stabilizer TMR	✓		✓	✓
Eastman Stabilizer Crimp	✓	✓		✓
Eastman Propcorn NC	✓	✓		
AIV Ässä Na			✓	

Figure 18. TMR stability can be substantially improved by using Eastman products.



Eastman Stabilizer TMR for improving stability

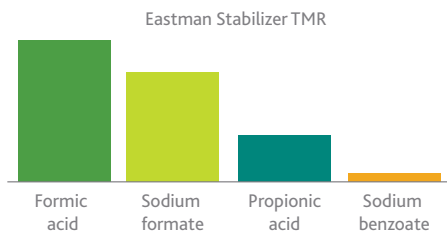
Eastman Stabilizer TMR is a user-friendly solution for improving TMR stability and hygienic quality while reducing nutrient losses. It should be added to the TMR at the time of preparation and should be mixed well into the entire batch. The sodium-based buffering makes the product non-ADR and helps reduce corrosivity and evaporation. These features make Stabilizer TMR convenient to use.

Active ingredients: formic acid, sodium formate, propionic acid, sodium benzoate, glycerin, propylene glycol



Eastman Stabilizer TMR for improving stability

Figure 19. The wide-ranging composition of Stabilizer TMR tackles several types of spoiling microbes.



4.2 Recommended application rates for TMR

Application for Eastman Stabilizer TMR is normally 1–5 L/ton well mixed within TMR. It is recommended to start by using 3 L/ton and adjust the application level in the following days to achieve the desired stability.

Application level varies depending on microbial load, quality of the ingredients used in the TMR, ambient temperature, and the frequency of TMR mixing.



5.1 Improving haylage quality

Your health and the health of your livestock is worth protecting through proper preservation methods. Dust and mold spores are common problems when handling hay, haylage, and straw, and moldy dust puts short- and long-term health of humans and animals at risk.

Hygienic quality can be substantially improved by treating hay and straw with Eastman Propcorn NC and wrapping the bales to eliminate oxygen. Wrapped hay, or haylage, has higher dry matter content and higher porosity than silage.

The wide-ranging composition of Eastman Stabilizer TMR makes it able to tackle several types of spoiling microbes in the haylage.

Haylage treated with Propcorn NC has better hygienic quality than untreated haylage and provides greater animal preference and better aerobic stability. In a first-choice trial, horses preferred haylage ensiled with Propcorn NC over untreated haylage.

Recommended application level for Propcorn NC for improving aerobic stability of ensiled hay is 5–8 L/ton. When moisture level is above 16%, airtight wrapping is needed to ensure high quality.

Figure 20. Eastman Propcorn NC improves aerobic stability of haylage.

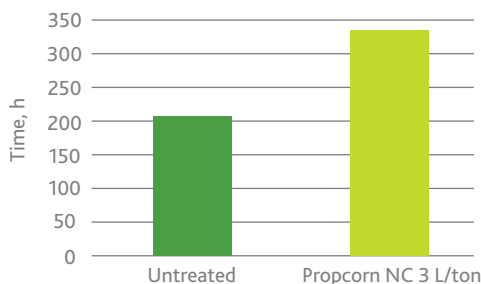
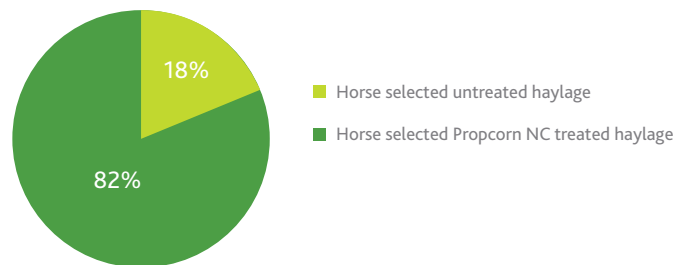


Figure 21. In a first-choice trial, horses preferred haylage treated with Eastman Propcorn NC.



Source: Luke, Natural Resources Institute Finland, 2012.

5.2 Extending the shelf life of brewer's grains

Brewer's grains offer ideal conditions for yeast. Ensiling is necessary to defer the utilization of brewer's grains. Apply Eastman Propcorn NC at 3–5 L/ton, mix product within the whole batch, and pack the brewer's grain in tube or otherwise compact to exclude oxygen. Minimizing air penetration into the batch will delay spoilage.

If the brewer's grain is aerobically stored, it is recommended that the batch will be consumed within two to three weeks of unloading, depending on the ambient temperature. Application rate of Propcorn NC for aerobic storage is 3–5 L/ton, depending on the desired storage time. Use the higher rate for longer preservation time.

6.1 Combine efficacy with safety.

Eastman works with customers to deliver innovative products and solutions while maintaining a commitment to safety and sustainability. Our superior-quality ensiling and feed preservation solutions help ensure safe, high-quality feed for livestock.

User experience and machine durability are taken into consideration in product development for safe and effective products. Our product compositions are significantly more user friendly than pure acids because they are buffered with the salt (formate or propionate) of the respective acids.

Customer safety is very important to Eastman. Be sure to wear the proper protective clothing and equipment, including gloves, respiratory and eye protection, and other personal protective equipment during product handling. Always have water available to rinse potential spills. Additional information on safety can be found in the product safety data sheets.

6.2 Organic acids are naturally present in living cells.

Organic acids have many positive effects on feed quality and animal performance—and they can also be found in nature. For instance, formic acid is found in ants, wasps, and nettles. And propionic acid is produced by microbial fermentation in the rumen and colon. For ruminants, propionic acid is an important source of energy and a precursor of blood glucose and milk lactose.

Our products also contain organic acid salts such as formate, propionate, and sorbate. Sorbate is the salt derived from sorbic acid, and benzoate is the salt derived from benzoic acid. Sorbic acid and benzoic acid are naturally present in many berries, such as lingonberry. These organic acid salts contain minerals, including sodium or potassium.

Advanced products are composed of a synergistic blend of different organic acids whose combined effects extend the effectiveness against a wider range of harmful microbes.

6.3 Product recommendations

Choosing the right product for each application is essential for successful ensiling and preservation. Refer to the following table for the appropriate products for your application.

	Forage ensiling grass, whole crops, maize		
	Dry matter %		
	Unwilted, < 30%	Prewilted, 23%–45%	Haylage, > 40%
AIV 2 Plus Na			
AIV 3 Plus Na			
AIV 2000 Plus Na			
AIV Ässä Na			
AIV Pro NC			
Eastman Propcorn NC			
Eastman Propcorn Plus			
Eastman Stabilizer Crimp			
Eastman Stabilizer TMR			

	Grain crimping (anaerobic)		Aerobic grain preservation		Total mixed ration (TMR)
	Moisture %		Moisture %		
	15–30	30–45	15–25	25–30	
AIV 2 Plus Na					
AIV 3 Plus Na					
AIV 2000 Plus Na					
AIV Ässä Na					
AIV Pro NC					
Eastman Propcorn NC					
Eastman Propcorn Plus					
Eastman Stabilizer Crimp					
Eastman Stabilizer TMR					



Choose Eastman.

Preservation of farm-produced feed can be demanding, with many aspects to consider. It helps to partner with an expert. Farmers and feed producers can leverage Eastman's formulation expertise and decades of industry experience—steeped in scientific know-how. Our regional teams have a deep understanding of local conditions, challenges, and breeds to offer best-in-class technical support.

With the widest portfolio of organic acids, Eastman offers a broad selection of well-documented solutions for preservation, hygiene, and gut health. We take a collaborative approach throughout the value chain, and we share your sense of stewardship for animals and the environment.

In the end, successful preservation will not only increase your yields. It's an investment in the well-being of your animals and workers.

To learn more or to schedule a visit, contact animalnutrition@eastman.com or go to eastman.com/animalnutrition.

EASTMAN

The results of insight™

Eastman Corporate Headquarters

P.O. Box 431

Kingsport, TN 37662-5280 U.S.A.

U.S.A. and Canada, 800-EASTMAN (800-327-8626)

Other Locations, +(1) 423-229-2000

www.eastman.com/locations

Although the information and recommendations set forth herein are presented in good faith, Eastman Chemical Company ("Eastman") and its subsidiaries make no representations or warranties as to the completeness or accuracy thereof. You must make your own determination of its suitability and completeness for your own use, for the protection of the environment, and for the health and safety of your employees and purchasers of your products. Nothing contained herein is to be construed as a recommendation to use any product, process, equipment, or formulation in conflict with any patent, and we make no representations or warranties, express or implied, that the use thereof will not infringe any patent. NO REPRESENTATIONS OR WARRANTIES, EITHER EXPRESS OR IMPLIED, OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, OR OF ANY OTHER NATURE ARE MADE HEREUNDER WITH RESPECT TO INFORMATION OR THE PRODUCT TO WHICH INFORMATION REFERS AND NOTHING HEREIN WAIVES ANY OF THE SELLER'S CONDITIONS OF SALE.

Safety Data Sheets providing safety precautions that should be observed when handling and storing our products are available online or by request. You should obtain and review available material safety information before handling our products. If any materials mentioned are not our products, appropriate industrial hygiene and other safety precautions recommended by their manufacturers should be observed.

© 2021 Eastman. Eastman brands referenced herein are trademarks of Eastman or one of its subsidiaries or are being used under license. The ® symbol denotes registered trademark status in the U.S.; marks may also be registered internationally. Non-Eastman brands referenced herein are trademarks of their respective owners.