Against the Grain:
Eliminating No-till Inputs for Healthier Soils & Higher Profits

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No-Till 2000 acre plant-based grain farm

Our Farm

- 23 years No-Till
- No Seed Treatments
- No Fertilizers
- No Insecticides
- No Fungicides
- No Pre-Harvest Desiccant

Bourgault 3710

Independent single disc tandem carts for placement of cover crop mix

<u>Benefits of No-Till</u>

- Wind/water erosion reduction
- Build soil structure & aggregate stability
- Increased water infiltration
- Increased nutrient cycling, increased gas exchange
- Reduced field operations
- Diesel fuel savings

<u>Challenges of No-Till System</u>

- Residue cycling/Maintaining residue
- Possible delayed seeding while waiting for field conditions to be optimal for minimum compaction

<u>Extreme Weather Conditions</u>

- Importance of being flexible in crop selection
- Cover crops may/may not be an option

<u>Maximizing Prevent Plant</u>

- Minimize compaction
- Using diverse mix of plant species to help build water infiltration and keep the soil microbiome fed during a non-crop year

- Originally built for ONE pass seeding & fertilizing. Variable rate fertilizers by soil type suggested by industry guidelines.
- Now used to apply 6-way cover crop mixes or multi-species cropping.
- Increased efficiency during optimal seeding conditions

Dual Carts

Haybuster 1000

Pulled by Cat 55

- **Egyptian Hulless Barley**
- **Spelt**
- **Ideal for small Regen areas, pollinator & wildlife habitat**

Over-Seeder Build

Over Seed Clover/Mustard/Oats onto Egyptian Hulless Barley Stubble
Waited for a 1” rain event

Wheat & Clover Intercrop

- Extends the carbon cycle after harvest
- Weed Suppression
- Potentially eliminates additional seeding pass in the fall
- Less fuel
- Less Hours on Equipment

*Challenge: eliminates herbicide pass

Wheat/Clover

Challenges

- On 4” of rain during growing season, clover used a significant amount of water needed for crop productivity
- Significant yield drag witnessed when moisture is limited

Oats-Mustard-Clover

- 3lbs of Oat/10lbs of Mustard in seed row/4lbs of YB Sweet Clover midrow
- Single Pre-plant herbicide
- Single Airseeder Pass
- No In crop herbicide
- No Post Harvest Seeding
- No post harvest separation of grain
- Mustard is marketable crop

Post Harvest Oat/Mustard/Clover

- Shelborne Stripper Head left a substantial amount of standing biomass
- Clover continues to capture carbon after harvest *If we get rain, volunteer oats & mustard will emerge

Oats/Peas/Mustard

- Eliminates In Season Herbicide Pass

<u>Challenges:</u>

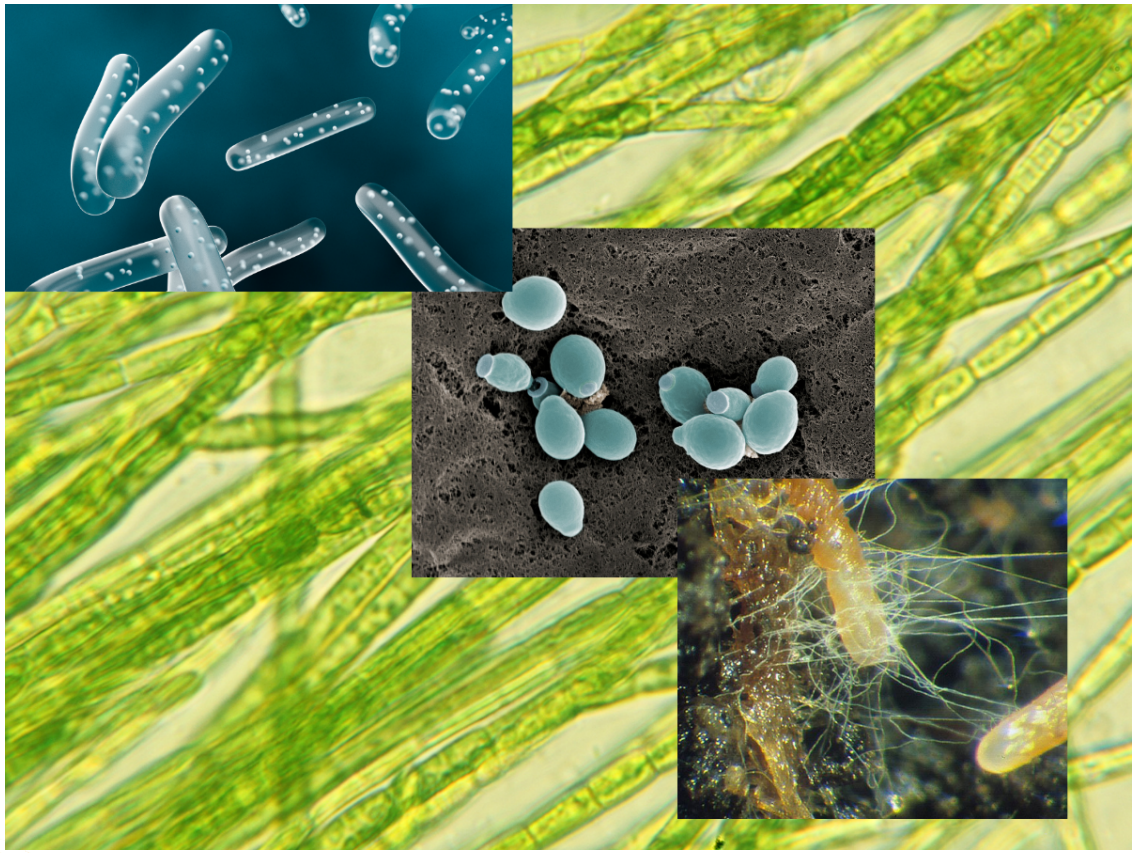
- Total production was less than mono crop peas
- Quality issue with oats
- Peas were overripe/splits
- Mustard shelled out
- Must be separated post harvest to sell.
- Still not separated; every handling operation costs time & money
- Flex cutting left no standing biomass for wind protection or snow catch
- Post harvest Cover Crop Seeding Pass

How can we add diversity without making things more complicated and costly??

Answer: Soil Biology

IMOS

Indigenous Micro-Organism Solution

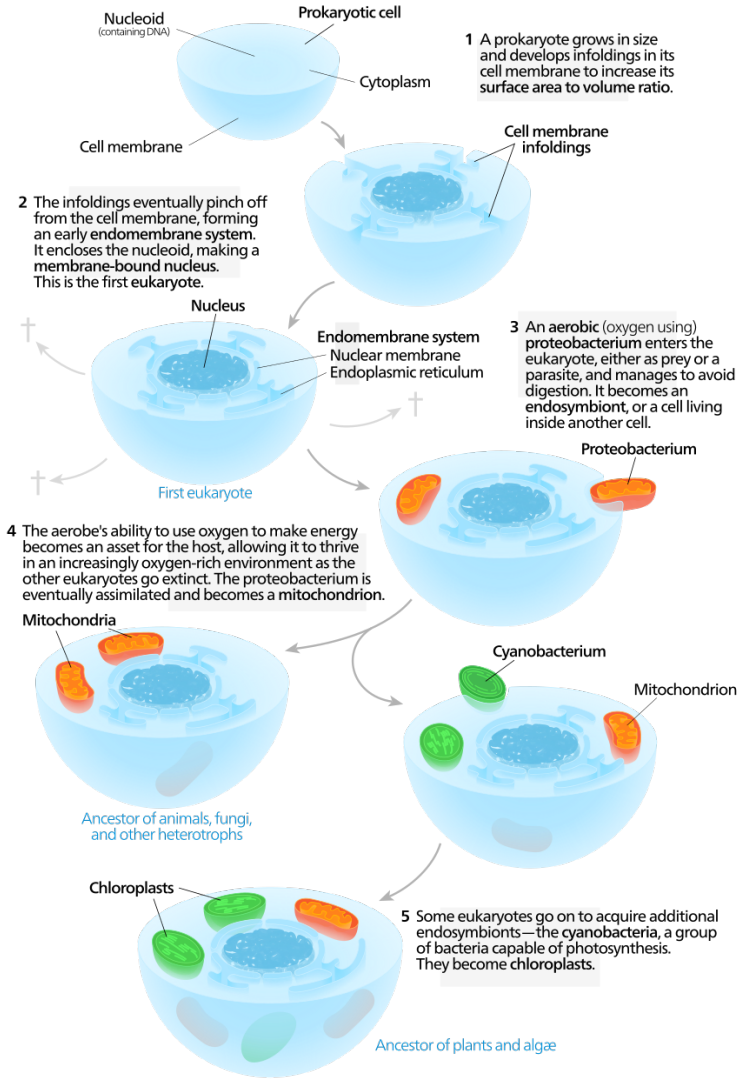


IMOS **bacteria/fungi=yeast/algae**

Borrowing Functional Cells From Our Native Thriving System

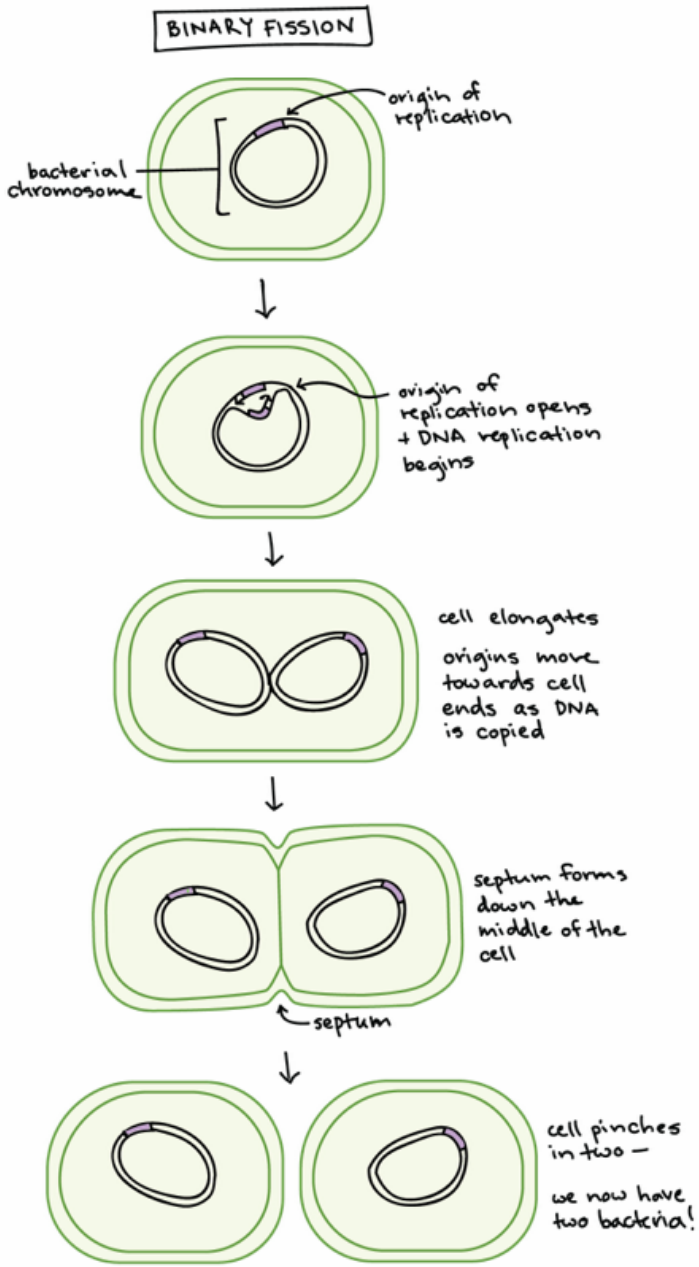
Functional Cells
can form symbiotic relationship with other cells to allow them to live within them.
If we are to understand how things end, we have to first understand HOW things begin

Disfunctional Cells=lack of oxygen caused by tillage or compaction (Equipment,livestock, bare ground & heavy rain)



On Farm Brewer Performs the Division of Functional Cells

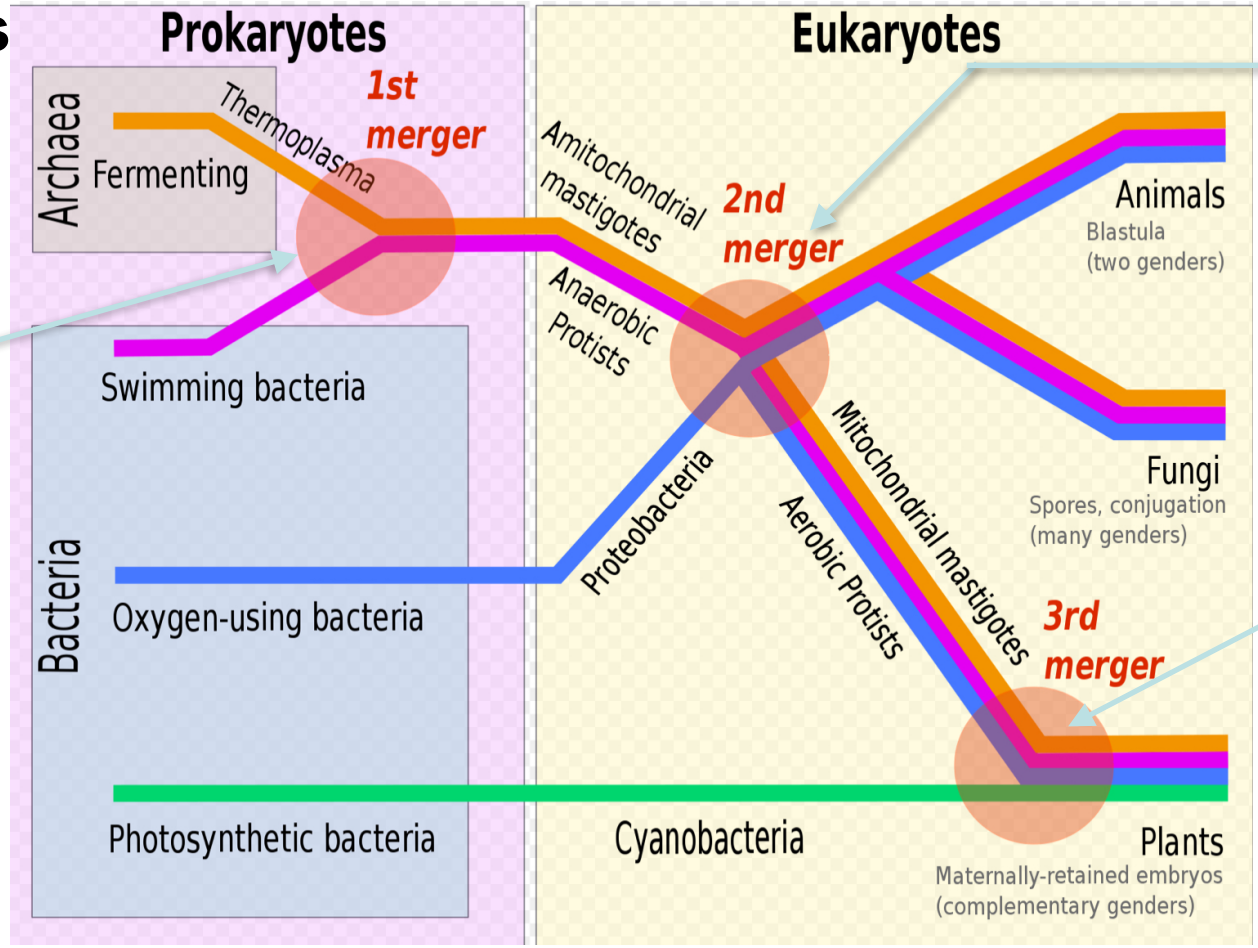
- Begin with the mother cell from **IMO**
- The mother cell is immortal(does not die)
- When the mother cell grows old it divides into 2 daughter cells
- **IMOS** completes a cell division cycle in 20 min
- A single cell can multiply to trillions in 24 hours.



3 key mergers of cells during IMOS:

Feed IMO

Endo-symbiotic Theory



IMO brewing with O2 using bacteria

IMOS Applied to Seed

Road Map to IMOS
Reset Button

Native Biology

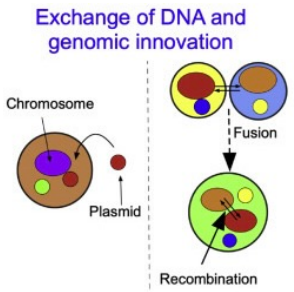
The best carrier for biology is the seed

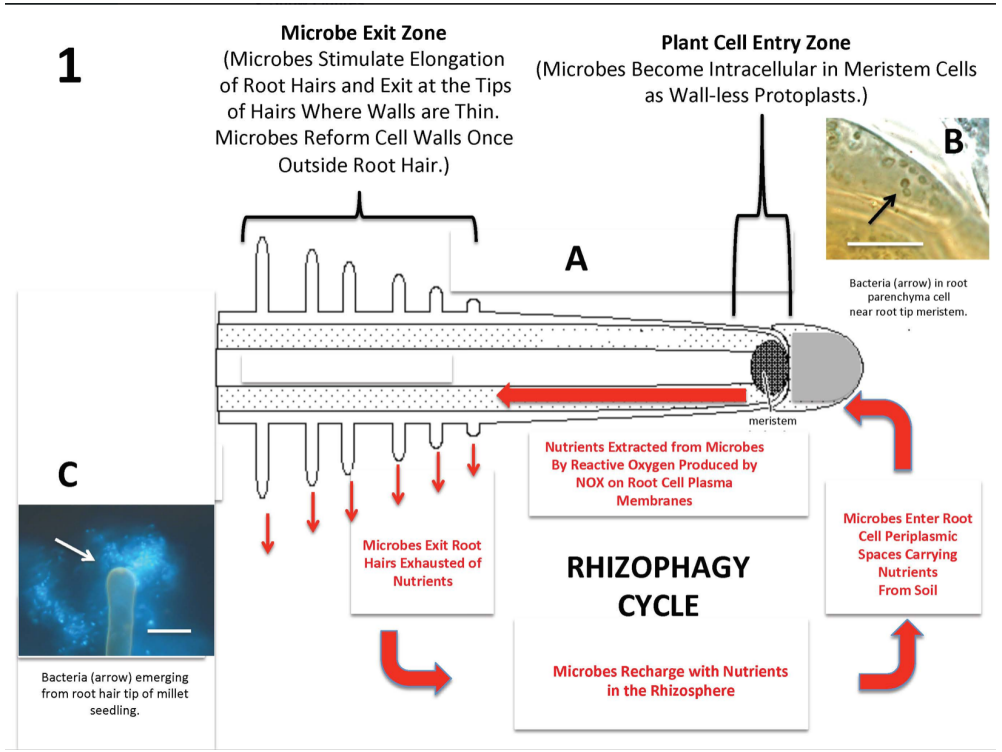
- Applied to the seed the functional cells get FIRST access to the plant (think Dr. Christine Jones' quorum sensing)
- There should be no other treatments
- IMOS forms biofilm(multi-cellular structures to protect the cells) on seed and goes dormant until it comes in contact with moisture from the soil
- Upon awakening biofilms disperse cells into their environment around the seed

Application

Removal of Cell walls

- Functional cells get eaten by roots
- Cell walls are removed without killing the cell.
- Wall-less Cells (exudates)get released into the soil where they reform their cell walls borrow & trade for nutrients & provides a unique opportunity to combine and make new cells





Spoon fed plants WILL NOT Engage in Rhizophagy Cycle

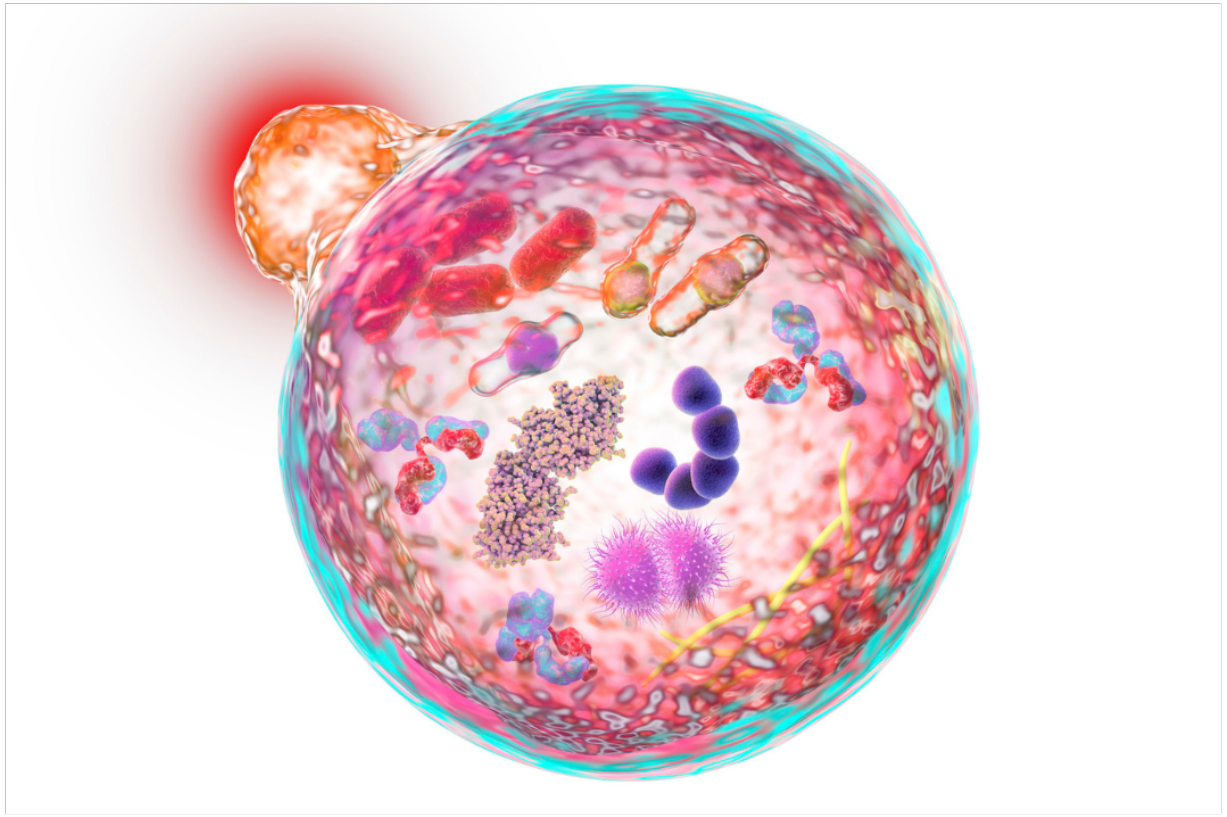
*Guardian Cell=Cutting Gate

How Can We Grow Our Crops With NO Inputs

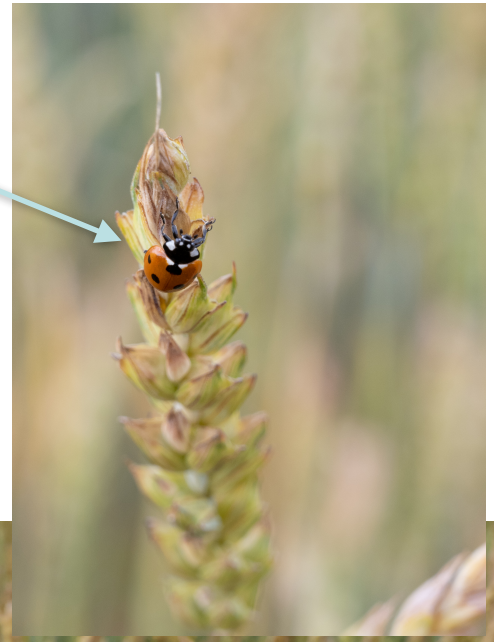
Evidence of Rhizophagy on our farm

Autophagy of Cells

- The host must fast to engage in recycling process of cells
- Functional cells consume dysfunctional cells creating of quorum of functional cells
- This process creates a suppressive system within our plants-eliminating the need for insecticides and fungicides
- It seems that cells may not be able to engage in Autophagy without first engaging in Rhizophagy.
- Without spoon feeding nutrients plants will heal themselves



Functional Cell



Dysfunctional Cells

The Only Way To Achieve The Impossible Is To Believe That It Is Possible

-Lewis Carroll

- Heritage wheat substantially taller 40-48” vs modern wheat 30”
- Easier to utilize Stripper Heads on heritage
- Heritage wheat has an aggressive canopy to suppress weeds
- Yield was the same
- Heritage Wheat Captured Carbon longer

Challenges of Heritage Wheat

- Longer maturity

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GROWING NUTRITION

Milling Oats/Malting Barley

- Produced Milling quality oats and malting barley with no added inputs
- Oats left outstanding amounts of biomass

Challenges

- Oats grown without a contract…now left to market 10,000 bushels or sell as animal feed
- Malting Barley was grown for a maltster who later decided to go gluten free at his malting facility
- Malting barley was short in height, only 28” tall, making is difficult to cut with stripper heads


MILLING
OATS
HARVEST
2022
GUARDIAN GRAINS

New American Stone Mill
Tuttle Rural Innovation Center
Tuttle, ND

Whole Nutrition Stone Milled Flours & Heritage Artisan Pasta

Questions???

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