

Q^ualitySense



QSorter[®]

High speed single kernel solutions for precise quality inspection, breeding and biochemical processing of seeds, grains and beans

One by One Analytics, from 30 to 3'000 seeds per second





QSorter®: High Speed Single Kernel Automation



Made in Switzerland

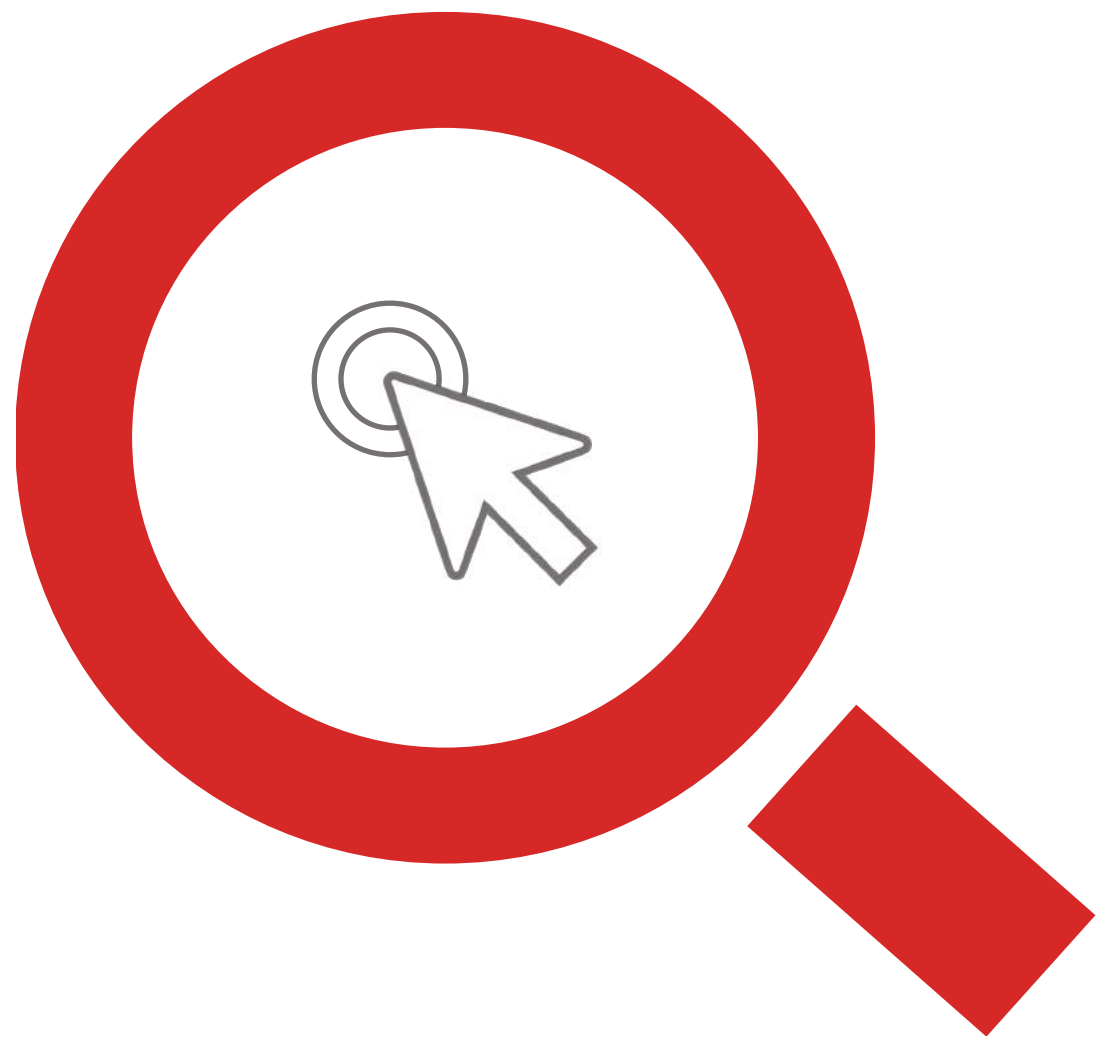
QualySense designs innovative high speed **single-kernel analytical and sorting devices** along with unique data solutions to **automate quality control, eliminate waste** and **improve market value of seeds, grains and beans**

QSorter® is the only technology able to measure invisible quality parameters from

30 to 3'000 kernels per second



Click Below to Visit our YouTube Channel



QSorter[®] **Explorer**



QSorter[®] **Horizon**



QualySense **Channel**





QSorter[®] Solution Portfolio: Clear Benefits



Breeding & R&D

10_x

Larger populations

1 by 1

Seed selection



Quality Control

> 80%

Less inspection time

> 30%

Sample cost savings



Smart Processing

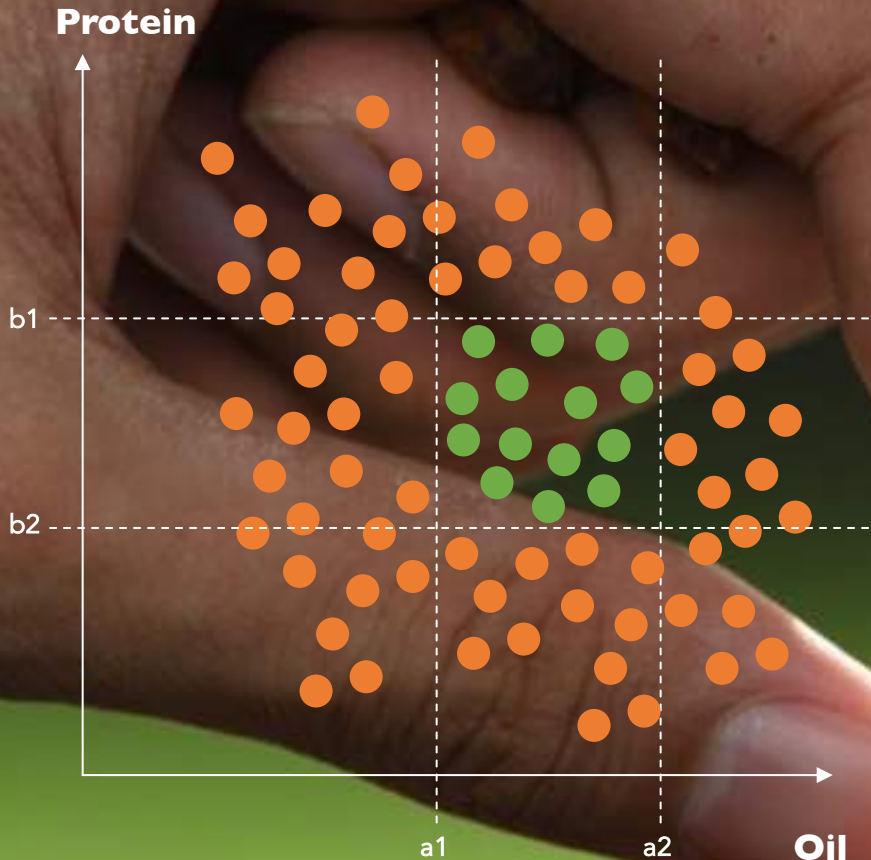
> 70%

Recovery of waste and discards

Up to 100%

Sorting Process Automation

QSorter® High-Speed Targeted Breeding and Food/Drink R&D



Key Benefits

- Enhanced seed selection
- Efficient field trials
- Accelerate breeding cycles
- Savings in laboratory analyses
- Sorting with multiple parameters:
 - ✓ Compositional properties
 - ✓ Physical properties
 - ✓ Defects and damages
- Non-destructive analyses
- Get several quality insights

QSorter® Automatic Grain by Grain Inspection

The **only robot in the world** for the **automatic inspection and grading of agricultural products**: each grain is analyzed at the amazing **speed of 30 kernels per second**



Key Benefits

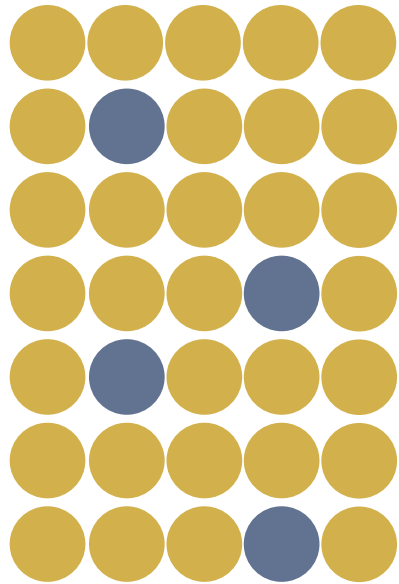
- Measure visual defects and compositional properties with just one instrument
- Eliminate subjectivity error
- Eliminate sampling error
- Up to 80% savings in infrastructure and personnel
- Share digital reports with 1 click
- Gain customer trust
- Non-destructive analyses



QSorter® Full Grading Automation

Step 1

Insert Sample in
the QSorter®



Step 2

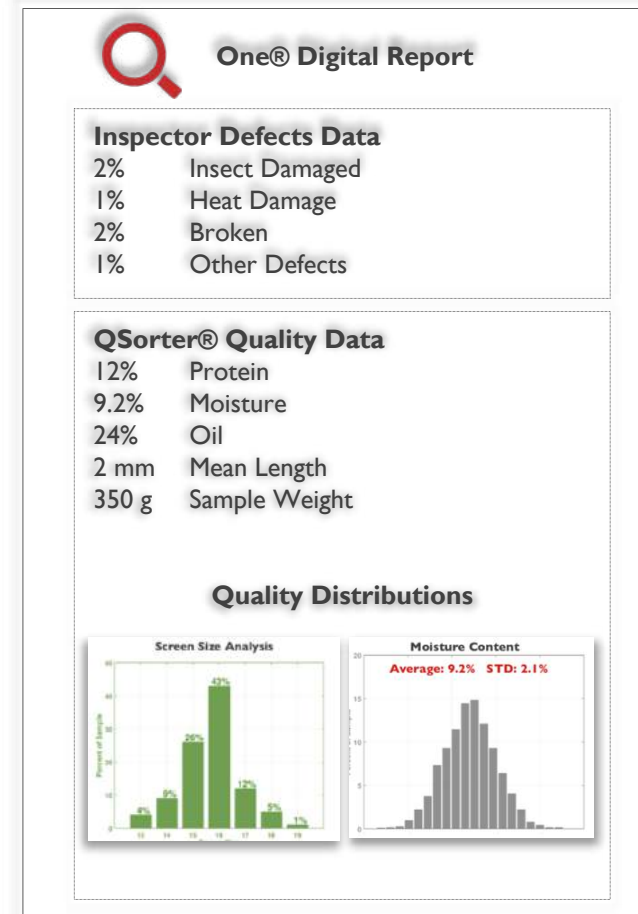
QSorter® Automatic
Inspection



30 kernels/s

Step 3

Share Full Report with
Customers and Colleagues

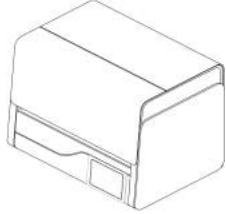


COMING SOON

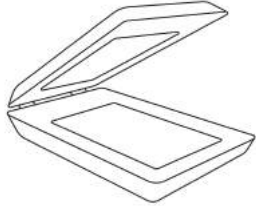


Gain Accuracy and Save Costs with the QSorter[®]

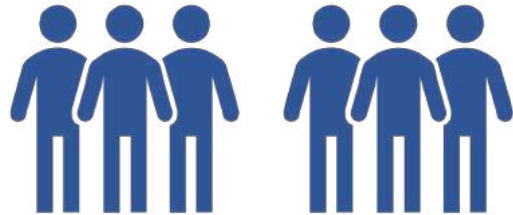
Today



NIR SAMPLE ANALYZER

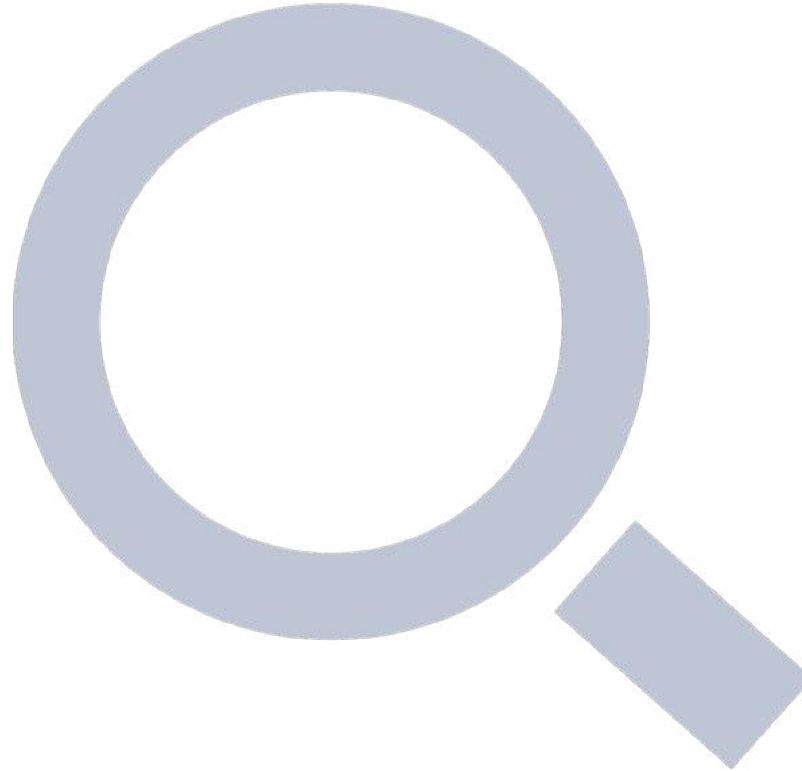


VISUAL SCANNER*



Challenges

- Subjectivity errors
- Slow process
- Sampling errors
- High infrastructure costs
- No data insights



Gaining Accuracy and Time



Benefits

- No subjectivity
- Fast process
- No sampling errors
- Low infrastructure costs
- Lots of data insights

QSorter® Compositional and Genetic Seed Processing

The **first industrial sorter in the world** able to **sort 3'000 seeds per second** with respect to genetic and compositional traits

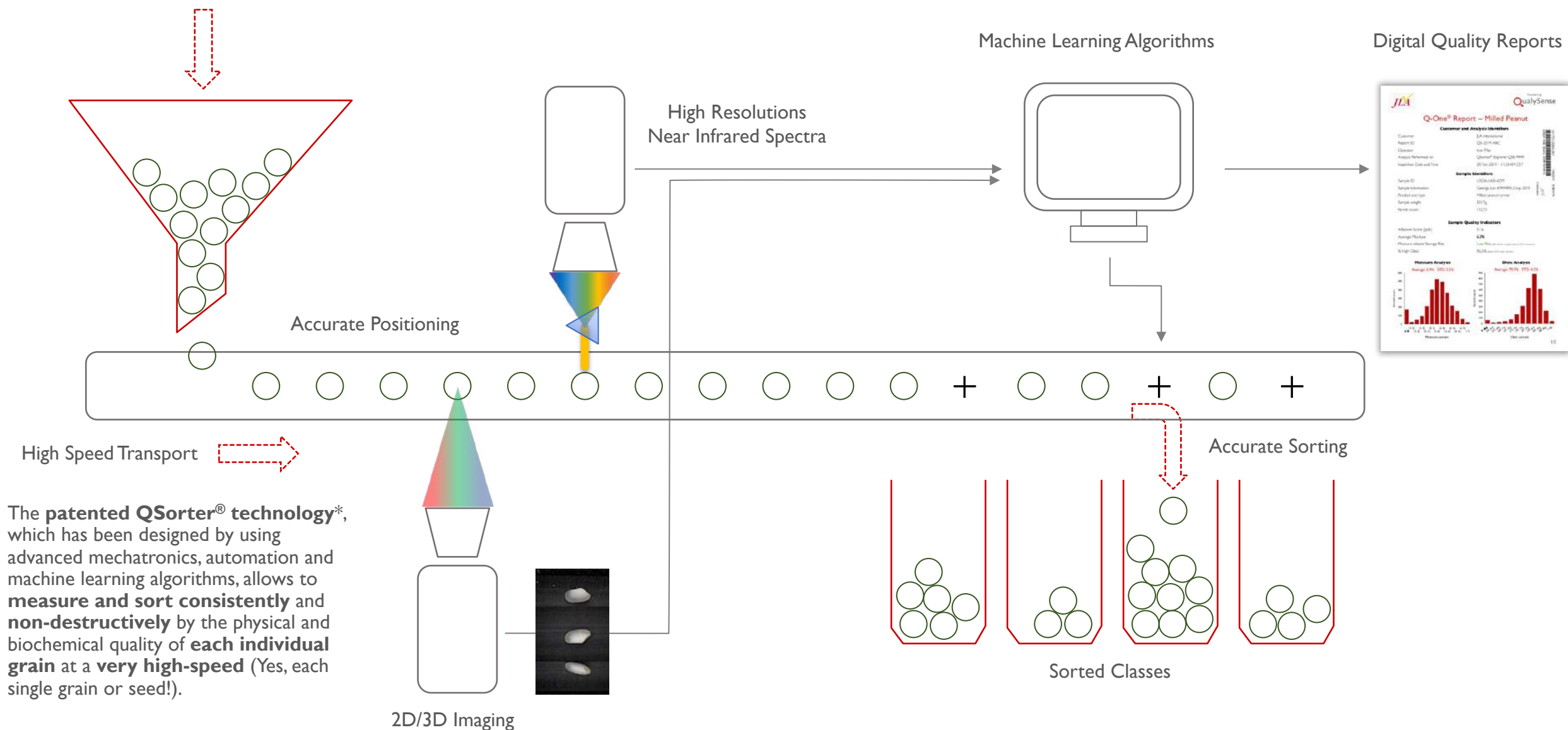


Key Benefits

- Sort seeds with respect to:
 - ✓ Genetic traits
 - ✓ Compositional traits
 - ✓ Physical purity
- Recover 70% or more of seed discards/culls
- Create seeds bags with higher germination rate
- Remove GMO contamination from organic lots
- Build business and process intelligence with seeds data



Advanced Sensing, Machine Learning, Sorting and Data

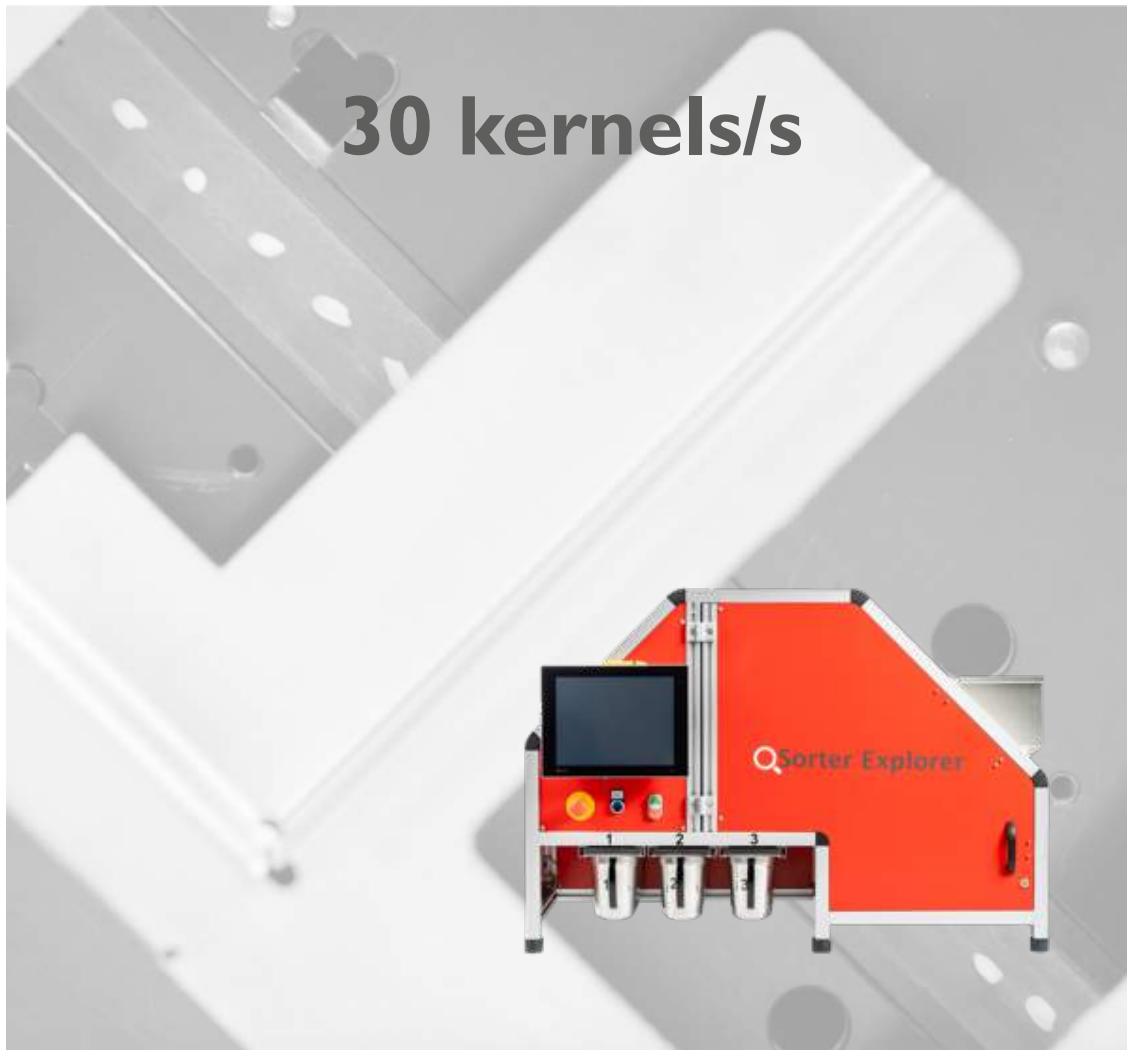




QSorter[®] Laboratory and Processing Platforms

QSorter[®] Explorer

30 kernels/s



QSorter[®] Horizon

3'000 kernels/s



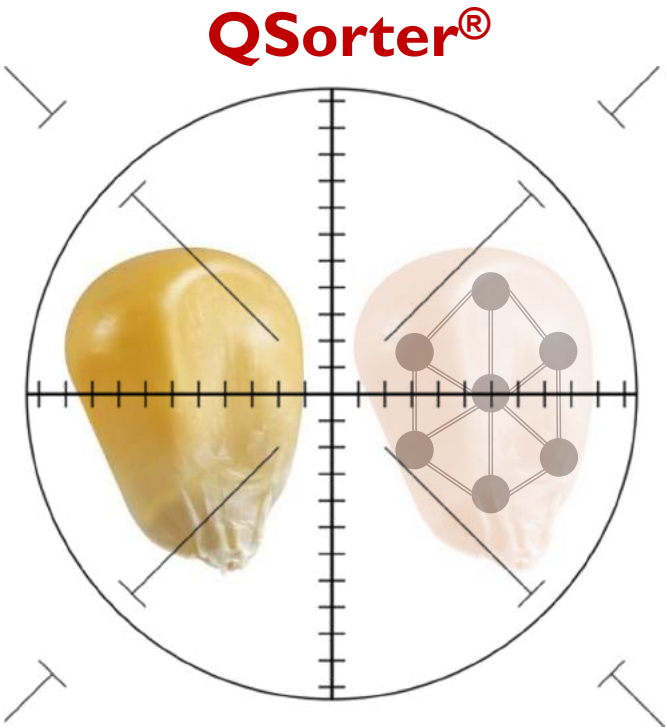


Several Single Kernel Quality Data for Great Benefits

PHYSICAL PARAMETERS

Length:	10 mm
Width:	7 mm
Thickness:	5 mm
Weight:	0.11 g
RGB Color:	(34,139,34)
Broken:	10%

2D/3D Color Image



COMPOSITIONAL PROPERTIES

Oil:	20.1%
Moisture:	12.3%
Starch:	23.1%
Protein:	10.2%

High Resolution Spectroscopy Signal

VISIBLE DEFECTS

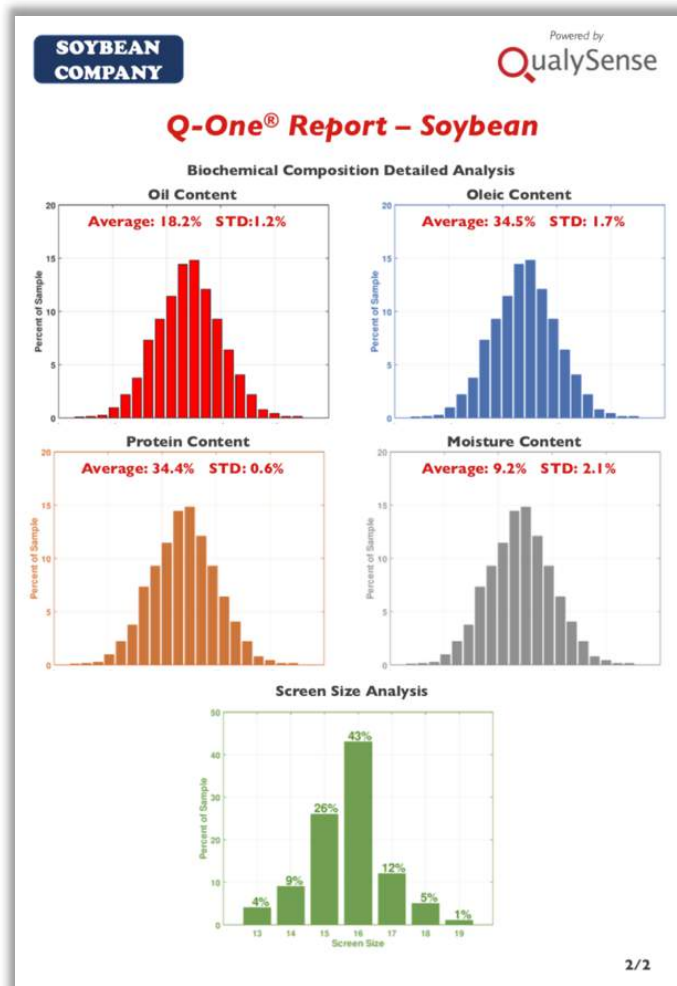
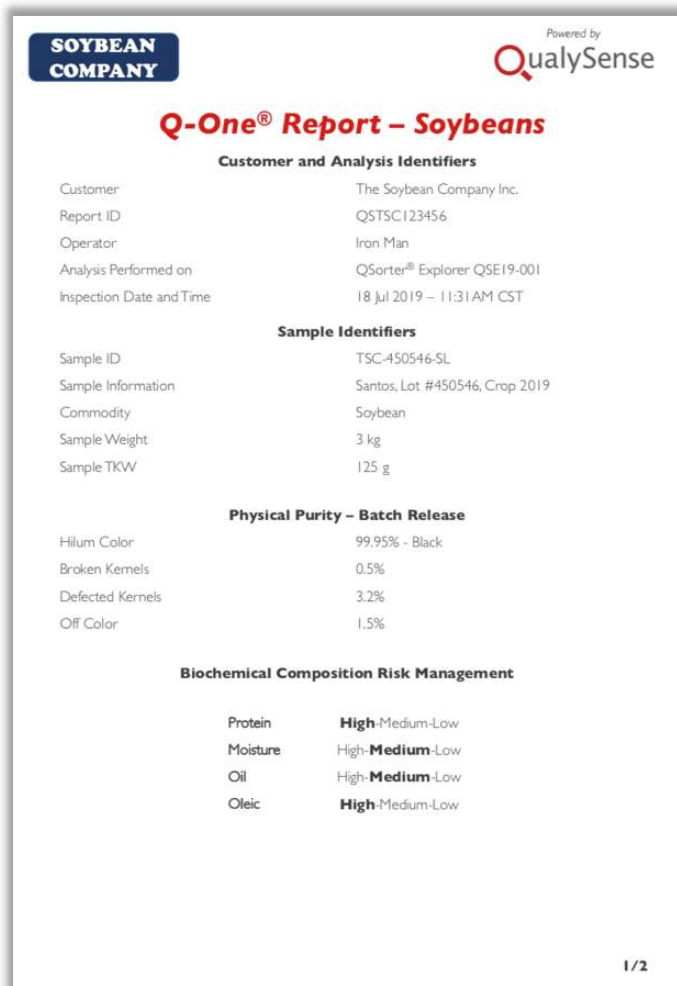
Discolored:	2%
Black bean:	4%
Immature:	1%
Damaged:	3%

PERFORMANCE AND PREFERENCE

Germination:	Very High
Purity:	97%
Aroma:	4.3
Toxin:	Not present
Shelf life	Long



Digital Reports for Selective Sorting and Business Intelligence



Example A

Selecting specific kernels

1. Collect data of one sample
2. Analyze distribution
3. Select threshold
4. Sort sample

Example B

Assess Process Efficiency

1. Collect data of one sample
2. Analyze distribution
3. Measure efficiency of plant
4. Fine tune machinery



Soybeans



Oleic Breeding
Protein, Fat and Oil Contents
Quality Control

Rice



Chalkiness and Broken Level
Quality Control

Corn



Haploid/Diploid Sorting
Discards Recovery

Peanuts



Aflatoxin Management
Quality Control
Oleic Breeding

Coffee



Removal of Taste Defects
Quality Control
Quaker Removal

Wheat



Quality Control Parameters

Oats



Gluten Contamination Control

Sweet Corn



Dent Removal
Pre-germ Removal
Broken Removal

Barley



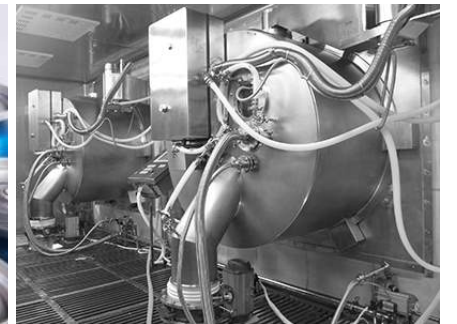
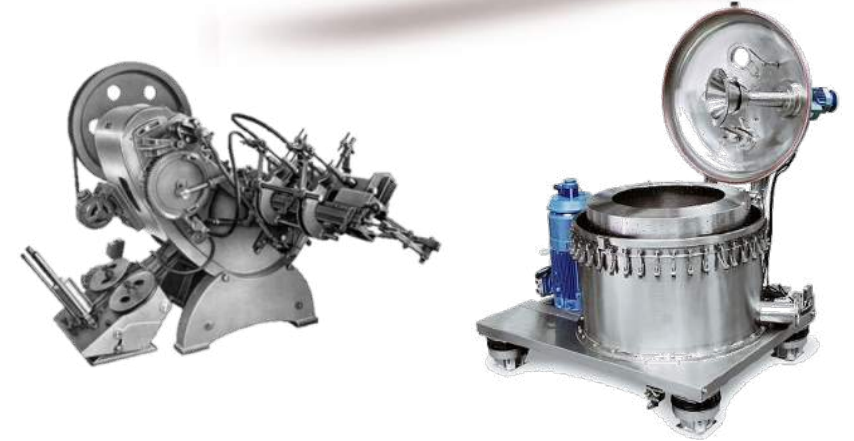
Quality Control



High Quality Production and Global Service Network



- Founded Switzerland, Ferrum Ltd. 1917
- Presence 70 countries
- Acquisitions
 - 2018: Spomasz-Wronki Sp. z o.o. and Hiller GmbH
 - Foundation Spomasz-Wronki: 1948
 - Foundation Hiller: 1971
 - 2019: Polypack Ltda. Foundation: 2000
- Employees worldwide 800, in addition 71 apprentices in 10 professions
- Shareholders Ferrum Ltd. Family owned since 1923





Founded in 2010, now with Customers Worldwide

Committed and Talented Management Team

Company Key Facts

- Founded in 2010
- 32 FTEs
- Offices in Zurich and Chicago
- Spinoff of space technologies
- Sales in 4 continents



Dr. Francesco Dell'Endice

Founder, CEO & Board
PhD, Rocket Scientist



Paolo D'Alcini

Founder, COO
Master Mechanics
Former CEO Rossopuro



Dr. Riccardo Tediosi

CTO & Digital
PhD, MBA
Former Bruker Director



Peter Huber

CFO *ad interim*
EM Corporate Finance
Former CFO Uster Tech.



Dan Klevisha

Senior VP Sales
Electric Engineering
Former President Foss USA

Top Global Customers Acquired



Seed Industry Solutions

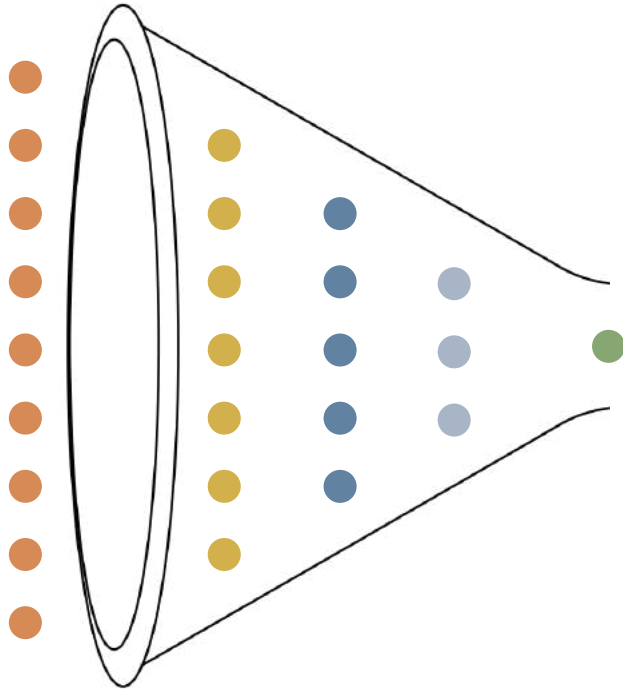




Seed Industry Challenges

Breeding

80% seeds wasted

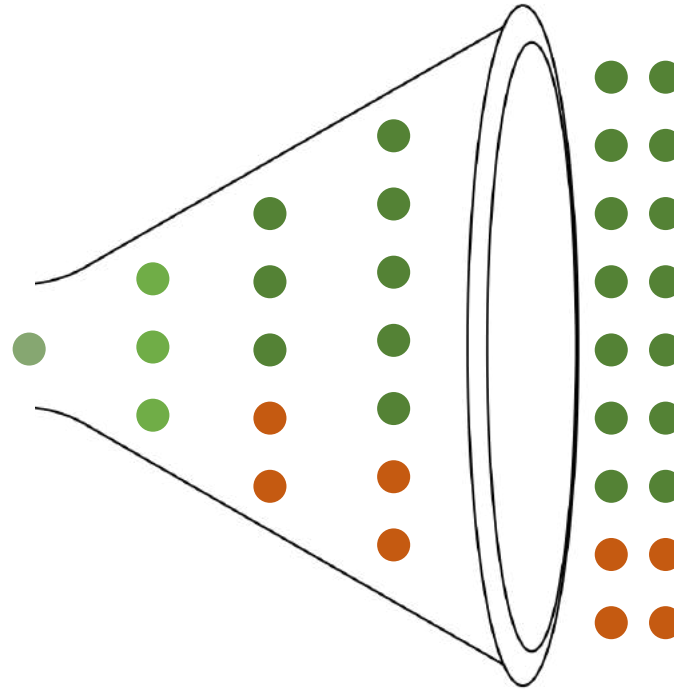


8 years

Phenotyping
Green Housing
Wet Chemistry
Molecular Testing

Multiplication

20% field losses

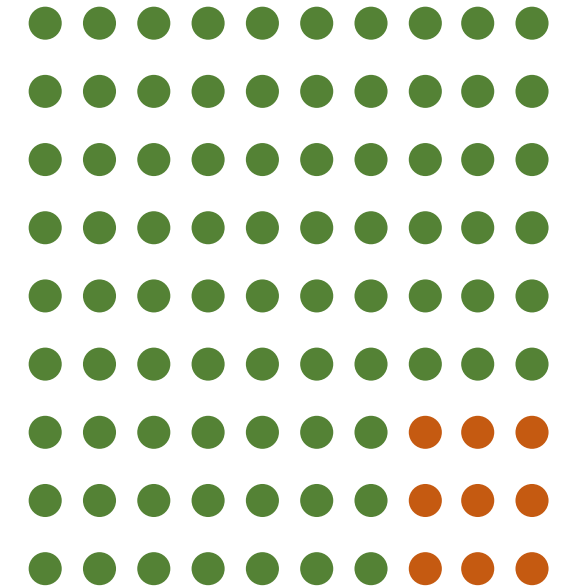


2 years

Selection
Multiplication
Trial Period
Product Advancement

Production

10% discards



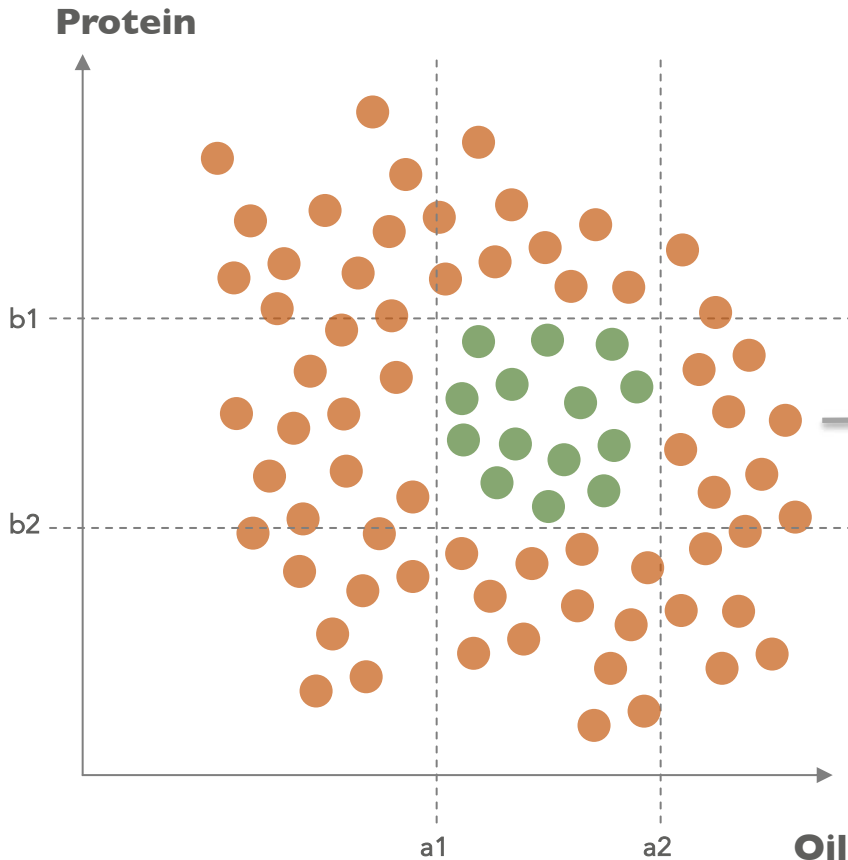
Planning
Processing
Delivering
Sales



QSorter[®] High-Speed Targeted Breeding

Key Benefits

- Enhanced seed selection
- Efficient field trials
- Accelerate breeding cycles
- Savings in laboratory analyses
- Sorting with multiple parameters:
 - Compositional properties
 - Physical properties
 - Defects and damages
- Non-destructive analyses
- Get several quality insights





- **Enhanced seed selection for more efficient trials**

the QSorter[®] enables breeders to rapidly select seeds with respect to desired traits (e.g. protein, oil). Therefore, more candidates are available for efficient field trials.

- **Savings in laboratory analyses**

the QSorter[®] can measure several compositional and physical parameters in a non-destructive way. This drastically reduces the need for other expensive laboratory analysis.

- **Reduce seeds waste by 50%**

as the field trials will contain a higher number of great seed candidates then the likelihood to bring a higher number of seeds to the next phase is higher.



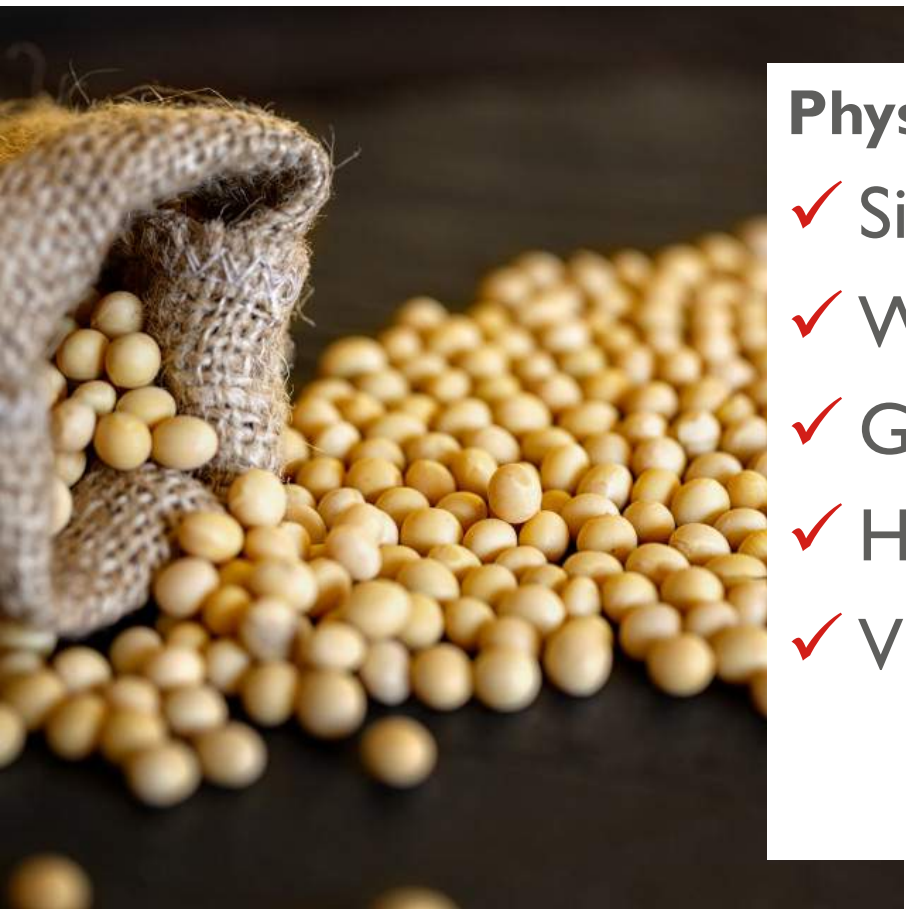
Soybeans

QSorter® Solutions



We have designed the most advanced and complete solution for

Soybeans Phenotyping



Physical Properties

- ✓ Size Analysis
- ✓ Weight Prediction
- ✓ Geometry
- ✓ Hilum Color (in progress)
- ✓ Visual defects (in progress)

Biochemical Properties

- ✓ Oleic
- ✓ Protein
- ✓ Oil
- ✓ Linolenic



- Rapid methods are not available
- NMR for characterization is slow
- Wet chemistry is expensive and time consuming
- Populations are small
- Assessing contamination is not possible





Example: **Breeding for High Oleic Soybeans**

The user aims at creating populations of soybeans with oleic content higher than 75%. Samples are screened by the QSorter[®] and only seeds with high oleic content are selected and propagated to the next generation. This process allows the breeder to increase the chances of success and shorten the breeding cycle.

Example: **Authenticating Germplasms**

The QSorter[®] generates a quality signature that is related to the characteristics of the germplasms. One signature (Data A) is collected before the commercial phase. At harvest, farmers are sending back samples and a second signature is acquired (Data B) and compared to Data A. This analysis allows the seed producers to understand if (1) there have been some issues in the field and (2) to detect fraud.



Corn

QSorter® Solutions



We have designed the most advanced and complete solution for

Corn Haploid Diploid Sorting



Physical Properties

- ✓ Color markers
- ✓ Size
- ✓ Shape

Biochemical Properties

- ✓ In progress



How Do You **Create a Pure Haploid** Sample?

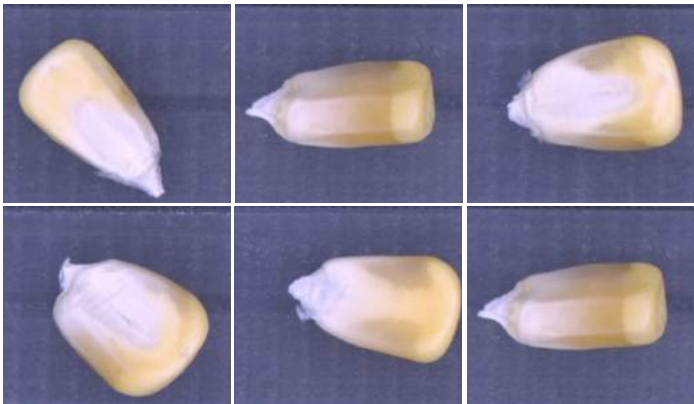
- The purity of the initial sample is very low, i.e. $< 10\%$
- Only small populations are available
- The selection is slow and expensive
- Seasonal personnel must be trained every year
- NMR sorting is slow
- Field results may be misleading





Artificial Intelligence and Automation

Images Training Set



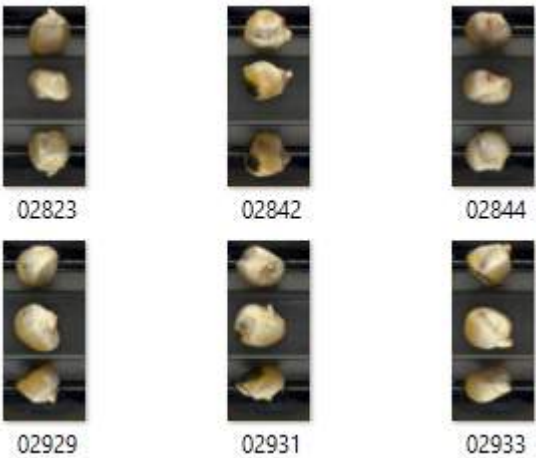
Machine Learning Algorithms



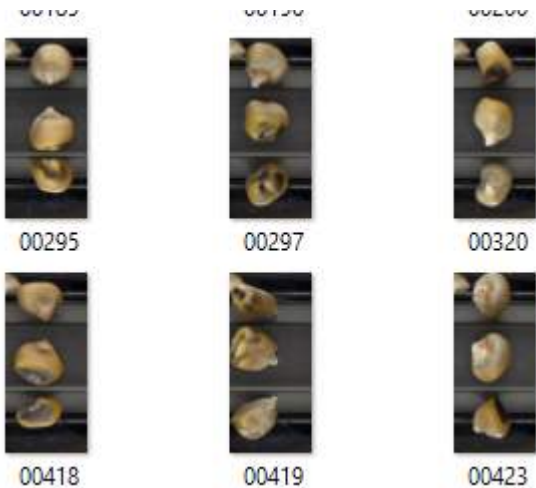
High Speed Sorting



Facing Camera



Not Facing Camera



Labelling



Tips



Pale marker





We have designed the most advanced and complete solution for

Corn Physical Properties



Physical Properties

- ✓ Broken
- ✓ Discolored

Biochemical Properties

- ✓ In progress



Sweet Corn

QSorter® Solutions



Increasing Purity of Sweet Corn for GMO-Free Compliance

**Dent
Kernels**



**Pre-Germinated
Kernels**



**Broken
Kernels**





Clear Benefits and Outstanding ROI



Reduce Manual Labor up to 100%

- Processing
- Inspection

Shorten “Sorting Season” up to 50%

- Done by Thanksgiving?

Recover up to 90% of rejects/culls

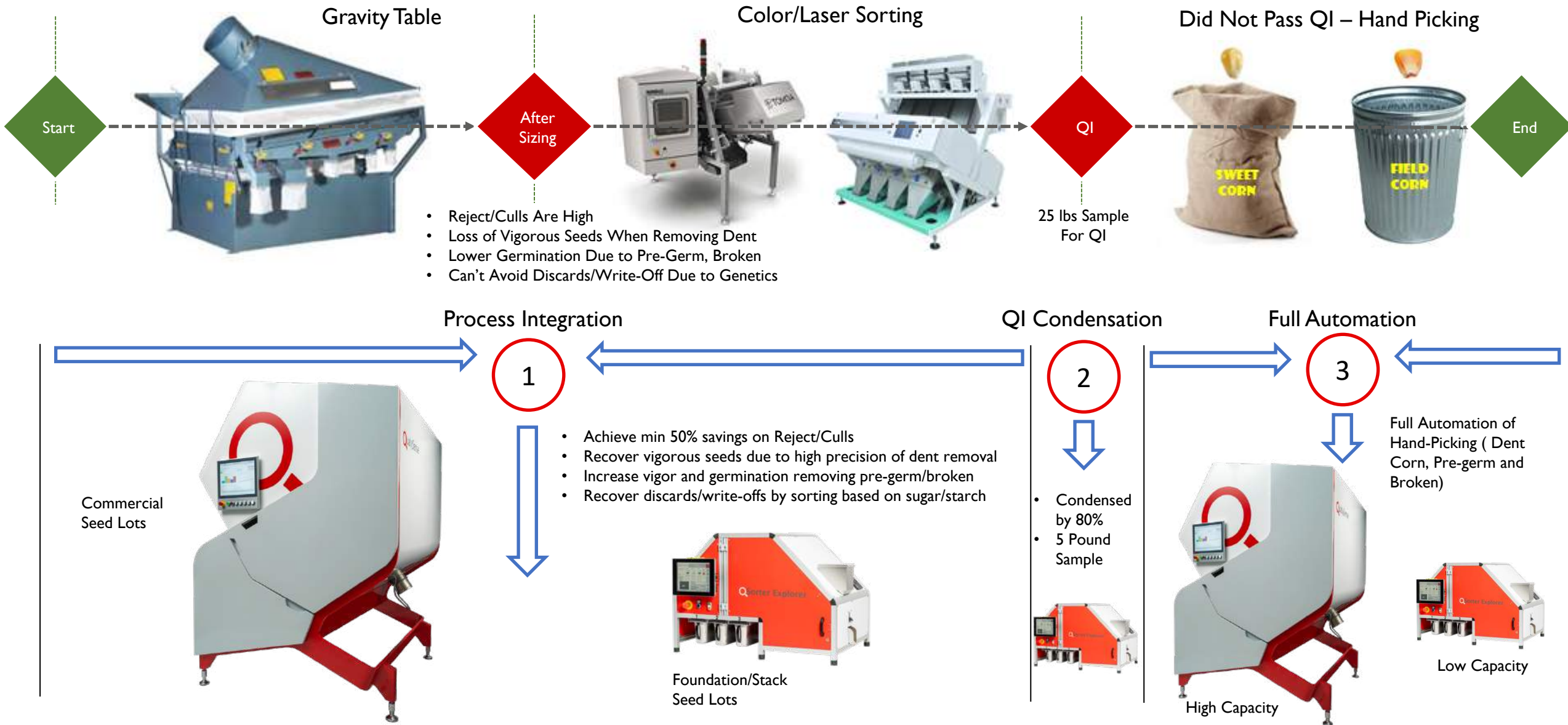
- Size
- Color

Other applications:

- Recovering Vigorous Seeds
- Recovering Discards/Write Offs
- Increasing Germination and Vigor
- Smart Sorting for Foundation and Stack Seed



Highest Precision of Sorting & QI Condensation





Attractive Pricing and Fast ROI

QSorter[®] Explorer



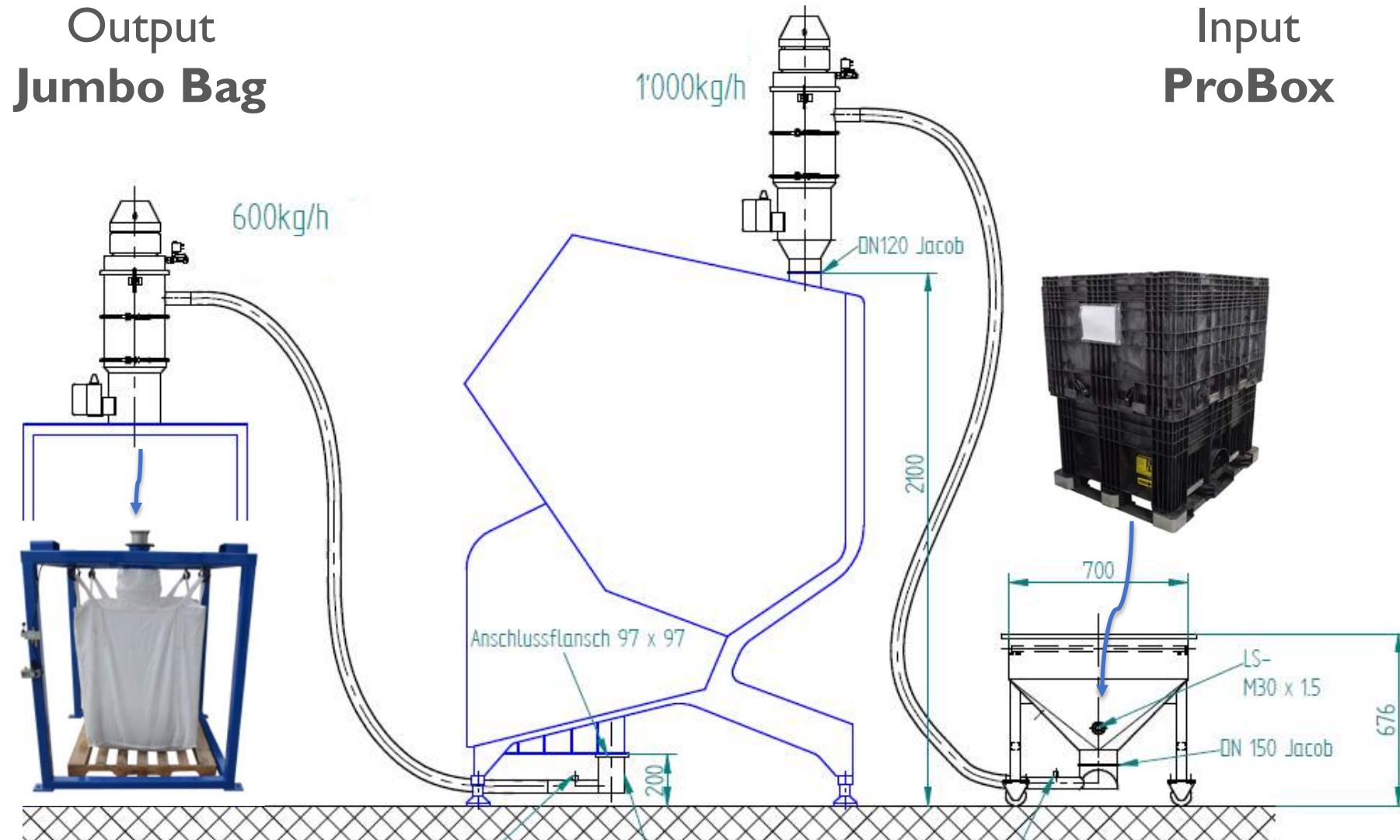
- **Price:** depends on volume
- **Fee:** premium for output ton

QSorter[®] Horizon





Potential Operations with the QSorter[®] Horizon



Quality Control Solutions





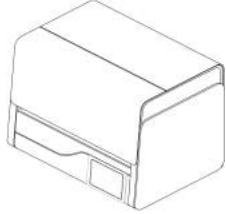
In current inspection practices:

- Time constraints allow inspection of small samples only
 - Sampling errors account for 90% of the error budget
- Inspectors analyze every kernel for visual defect and it is slow
 - Subjectivity and other factors can compromise the lot value
- Multiple instruments are used for various parameters
 - Costly, complex to maintain and increase error budget

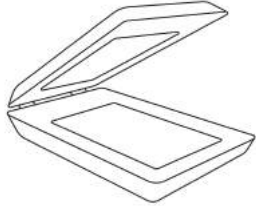


Gain Accuracy and Save Costs with the QSorter®

Today



NIR SAMPLE ANALYZER

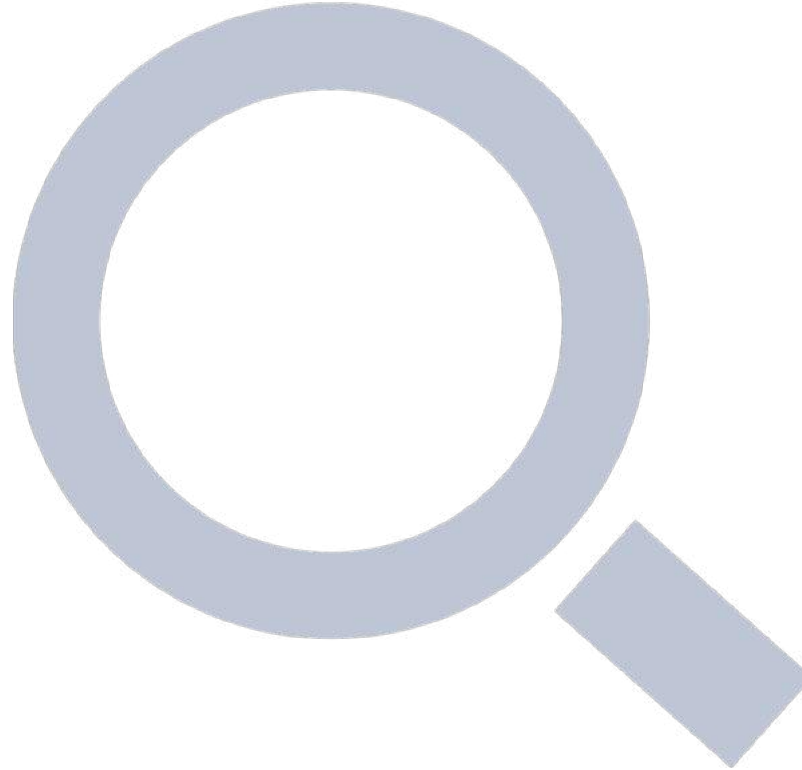


VISUAL SCANNER*



Challenges

- Subjectivity errors
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Gaining Accuracy and Time



Benefits

- No subjectivity
- Fast process
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Sound Kernels



Visually Defected





Sound



Head grains

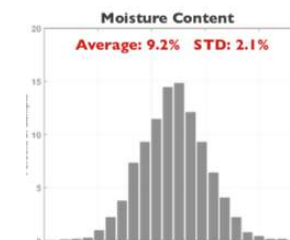
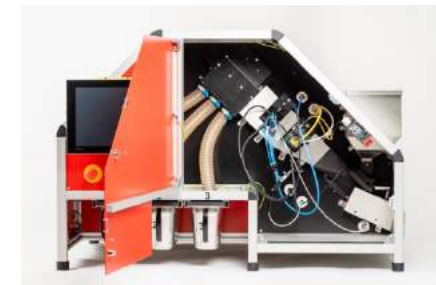
Broken



Broken grains



Top Notch Quality Control and Strong Savings





We are developing a cutting-edge solution

Barley Quality Control

Properties in Development



- ✓ Protein
- ✓ Moisture
- ✓ Size
- ✓ Color
- ✓ Beta-glucan
- ✓ Friability
- ✓ Contaminants
- ✓ Germination
- ✓ Fusarium
- ✓ DON



We have designed the most advanced and complete solution for

Rice Quality Control



Physical Properties

- ✓ Chalkiness Distribution
- ✓ Broken %
- ✓ Head %
- ✓ Color (Whiteness)
- ✓ Length Distribution
- ✓ Width Distribution
- ✓ Thickness Distribution
- ✓ Volume Prediction
- ✓ Weight Prediction

Biochemical Properties

- ✓ Protein
- ✓ Moisture
- ✓ Oil



We have designed the most advanced and complete solution for

Peanuts Quality Control



Physical Properties

- ✓ **Size Analysis**
 - ✓ Jumbo
 - ✓ Runners
 - ✓ Virginia
 - ✓ Super Jumbo
- ✓ **Weight Prediction**
- ✓ **Split %**
- ✓ **Defected Kernels %**

Biochemical Properties

- ✓ **Flags Toxin Risky Kernels**
- ✓ **Oleic**
- ✓ **Moisture**



We have designed the most advanced and complete solution for

Oats Gluten Free Control



Physical Properties

- ✓ Geometry

Contaminants Detection

- ✓ Barley
- ✓ Rye
- ✓ Wheat



Contact us for more information

qualysense.com



Dr. Riccardo Tediosi

Chief Technology & Digital Officer

riccardo.tediosi@qualysense.com



Daniel Klevisha

Senior Vice President of Sales

daniel.klevisha@qualysense.com



Dr. Francesco Dell'Endice

CEO & Founder

francesco.dellendice@qualysense.com



Onur Hancer

Head of Sales & Business Development, Seed

onur.hancer@qualysense.com

