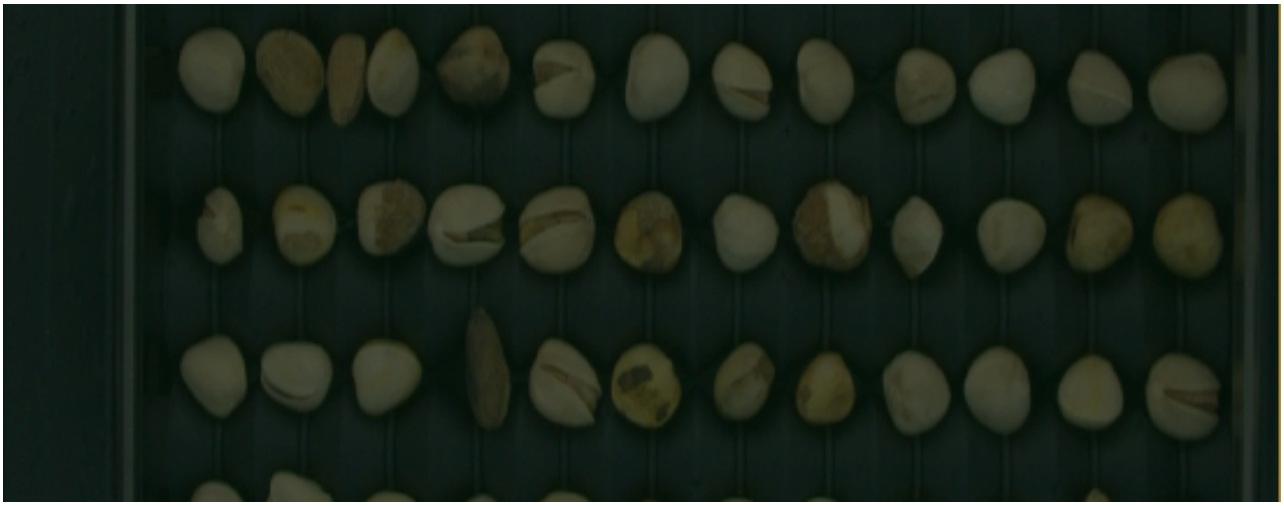
SES

TECHNICAL & COMMERCIAL DOCUMENT

PISTACHIOS: AI THAT KNOWS WHAT IT SEES

Sorting by opening, size, quality and defects with open learning and customer control



THE SES DIFFERENCE

All leading manufacturers use advanced vision and artificial intelligence. SES stands apart because its AI interprets the pistachio as a whole, recognizes anomalies, learns new categories and turns the customer's criteria into a repeatable industrial decision.

99,6 %	360°	<0.4 %
EFFICIENCY	**VISUAL COVERAGE**	**FALSE REJECTION**
SES multiclass configuration	Rotation or multi-view architecture	Documented pistachio target

SES is the new name of Qhuantum. August 2026.

1. EXECUTIVE SUMMARY

Visual intelligence designed to distinguish the true commercial value of each pistachio.

Pistachio sorting is one of the most demanding tests for any vision system. Separating light and dark product is not enough. The machine must determine whether the opening is natural or mechanical, distinguish partially open from closed nuts, assess size, color, stains, integrity, plant debris, insects, mold and foreign materials, and turn that assessment into a commercial grade.

THE CORE PROPOSITION

SES does not deliver a closed, fixed recipe for pistachios. It delivers intelligence capable of observing, understanding and learning. Customers can define what they consider premium, standard, industrial or reject grade and teach those criteria to the system using their own samples.

1 HOLISTIC UNDERSTANDING

Integrates opening, shape, color, texture, defects and the context of the complete piece.

2 OPEN LEARNING

Can detect deviations even when no specific class exists for every future defect.

3 CUSTOMER-TRAINABLE

New varieties, tolerances and categories are learned using real product.

4 PROVEN PERFORMANCE

Efficiency of up to 99.6% in SES multiclass configurations.

The advantage becomes clear when several signals appear at once: a pistachio may be open but stained, large but empty, or have a hairline crack that places it between partially open and closed. SES resolves the complete decision for every individual nut.

2. AI EQUIVALENT TO THE EXPERT HUMAN EYE

It does not merely compare pixels: it interprets the entire pistachio and applies learned criteria.

An experienced inspector recognizes at a glance the difference between a valuable natural opening and a hairline crack; determines whether a stain is superficial or compromises presentation; detects breakage, insect damage or plant debris; and decides the commercial destination. SES transfers this functional logic to an industrial line.

KNOWING WHAT IT SEES

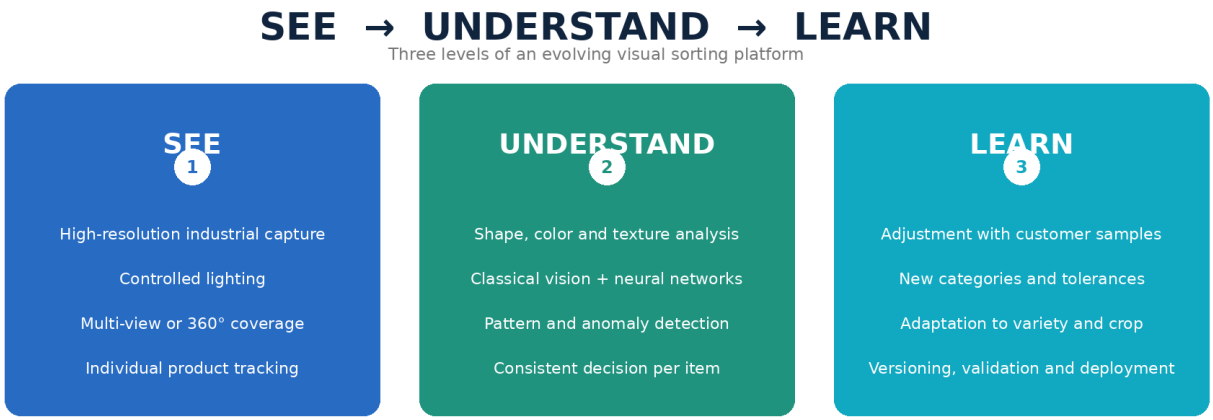
The expression does not imply human consciousness. It means that the model relates opening, geometry, color, texture and anomalies within a coherent representation of the product, rather than treating them as isolated rules.

CAPABILITY	HUMAN INSPECTOR	SES AI
Opening	Interprets the crack and whether it is natural	Analyzes width, continuity, shape and context across multiple views
Consistency	May vary between operators and shifts	Maintains the same criteria throughout production
Fatigue	Loses attention over time	Operates without loss of attention
Subtle defect	Limited by speed and lighting	Detects microdefects under controlled optical conditions
Learning	Learns from samples and experience	Learns new classes and tolerances using the customer's product

The industrial difference is that this understanding is combined with speed, traceability and automatic separation. Every nut is observed, classified, recorded and routed to its outlet in real time.

3. SEE, UNDERSTAND AND LEARN

Three levels that turn pistachio vision into a decision platform.



SEE

Visual coverage is critical because an opening or defect may be on the hidden side. SES uses rotation, rollers or a multi-view architecture to increase the observed surface area and reduce blind spots.

UNDERSTAND

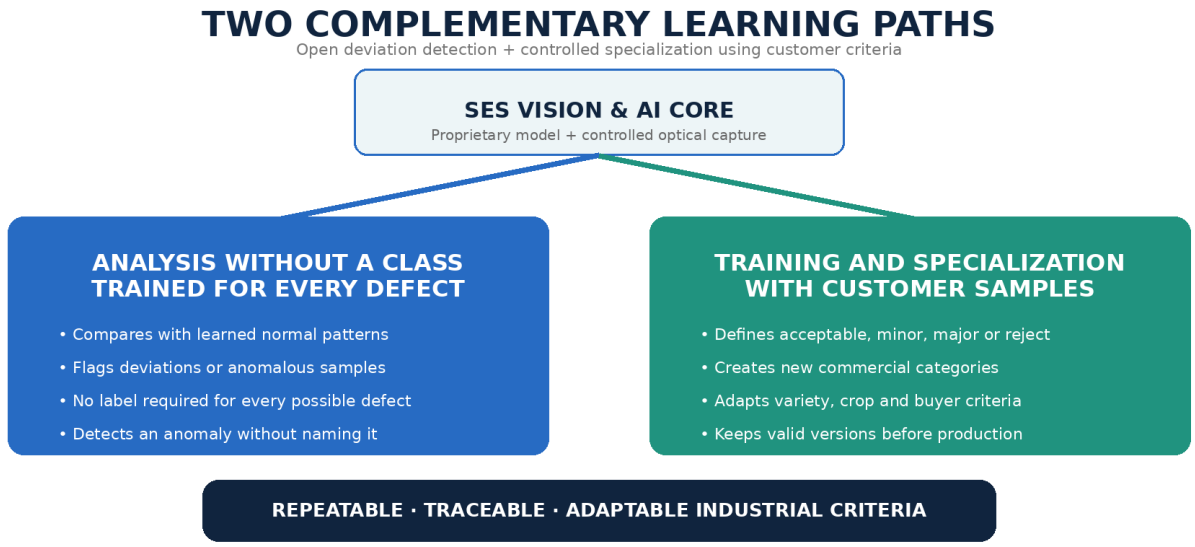
AI interprets the relationship between opening, size, integrity, color, texture and defects. Classical machine vision complements this with traceable measurements of contour, size, area, color and morphology.

LEARN

The system incorporates new examples from each crop, variety, defect or commercial specification. Knowledge is not frozen at the initial installation.

4. TWO COMPLEMENTARY LEARNING PATHS

SES can recognize a deviation before the customer has created a category for it.



1. RECOGNITION WITHOUT SPECIFIC TRAINING FOR EVERY DEFECT

SES starts with a base model, but does not need to anticipate and label separately every defect that might appear. Anomaly detection recognizes when an item deviates from the normal pattern, even before the commercial name of that deviation is known.

2. CUSTOMER TRAINING AND SPECIALIZATION

When the customer decides what that deviation means for its business, it provides examples and establishes the criteria: acceptable, reprocessing, premium, standard, industrial or reject. The model learns the new decision and applies it repeatedly and consistently.

CROP EXAMPLE

If a crop presents a new stain or different morphology, SES can detect it as a deviation, group examples and then turn it into an operational class defined by quality.

5. PISTACHIOS REQUIRE A MULTIDIMENSIONAL DECISION

Opening, size, visual quality, defects and commercial destination are resolved together.

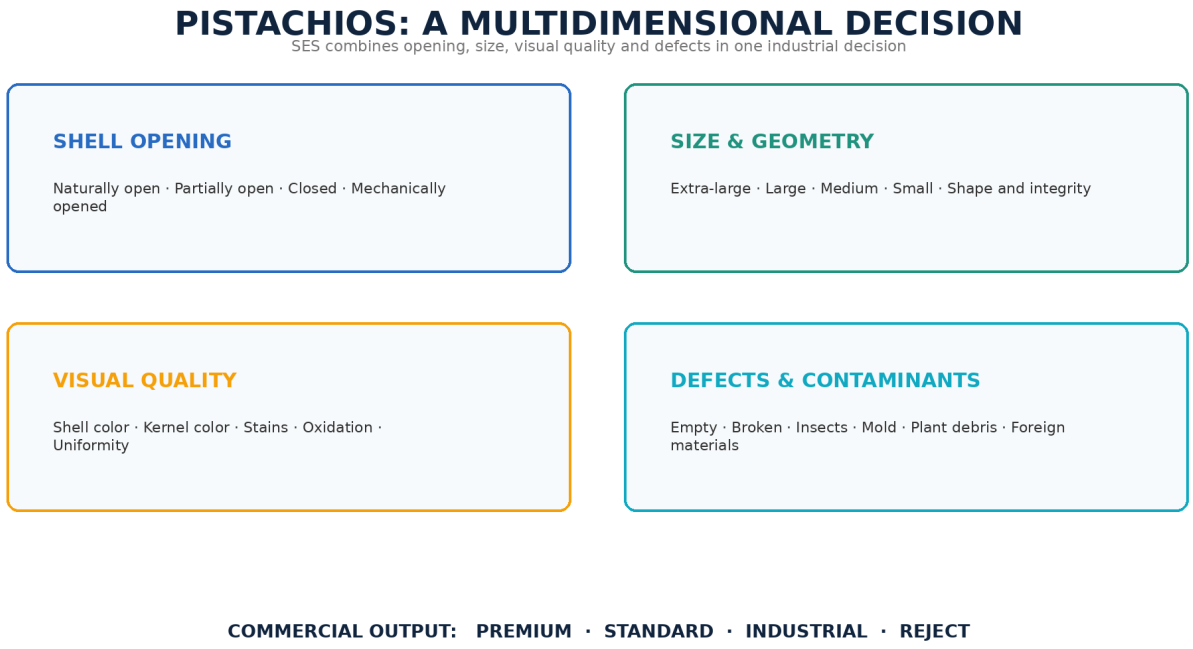


Figure 1. Functional taxonomy of pistachio sorting in SES.

The platform is not limited to open/closed separation. It can combine four opening states, four size ranges, shell and kernel color criteria, integrity, biological defects, plant debris and foreign materials, and assign a final commercial grade.

+5	20+	99,6 %
OPENING STATES	**CRITERIA AND STATES**	**SES EFFICIENCY**
Natural · Open · partially open · closed · mechanical	Size, color, integrity, defects and contaminants	Depending on multiclass configuration and protocol

PROOF OF CAPABILITY

The difficulty does not lie in detecting a single characteristic. It lies in resolving overlapping signals and translating them into a stable commercial decision for every pistachio.

6. WHY PISTACHIOS REVEAL THE LIMITS OF AI

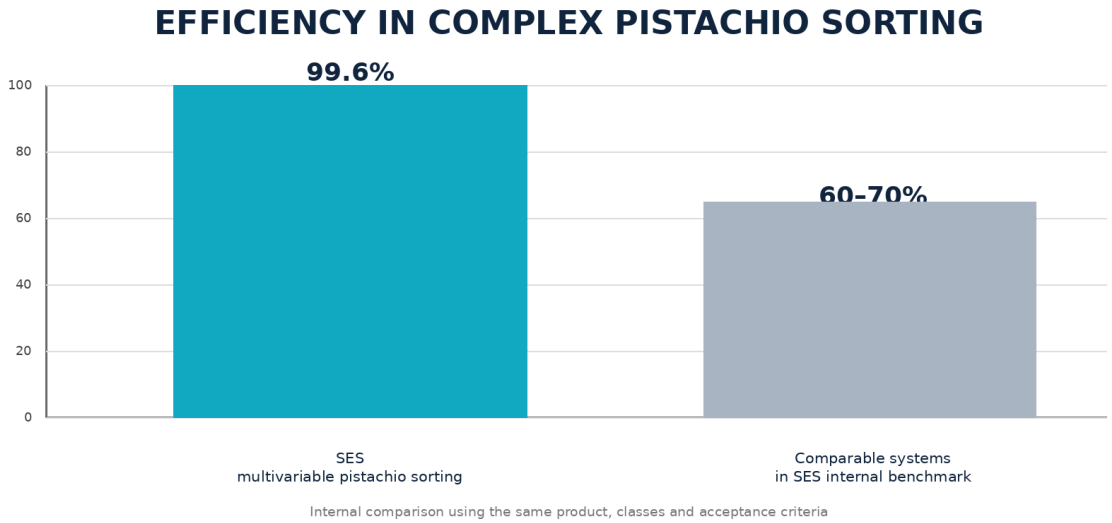
Simple systems work with obvious features; the difference emerges in ambiguous cases.

Figure 2. Opening states and their relationship to commercial value.

CHALLENGE	WHY IT IS DIFFICULT	SES RESPONSE
Hidden crack	The opening may be at a non-visible angle	Multi-view coverage or nut rotation
Partially open	The crack is minimal and can be mistaken for closed	Detailed analysis of opening geometry and continuity
Overlapping classes	An open nut may be stained, broken or empty	Signal fusion and multiclass decision
Natural variation	Color, shape and size vary between varieties and crops	Learning with samples from the actual batch
New defect	A closed list cannot cover every case	Anomaly detection followed by specialization

7. THE EFFICIENCY DIFFERENCE

Up to 99.6% compared with the 60–70% range observed in SES's comparable internal benchmark.



In the internal comparative scenario—the same product, classes and acceptance criteria—SES achieves up to 99.6% efficiency. The reference systems evaluated for the same challenge achieve approximately 60–70%.

WHY THE GAP WIDENS

When the problem moves from sorting by color or size to interpreting opening, severity, defect, variety and destination simultaneously, the quality of the representation learned by the AI becomes the decisive factor.

Note: the 60–70% range corresponds to SES's internal benchmark using an equivalent protocol. It should not be confused with commercial figures published by manufacturers for other products or metrics.

8. TECHNOLOGY COMPARISON WITH THE MARKET

All use AI or advanced vision. SES differs in understanding, breadth of criteria and customer autonomy.

The comparison focuses on publicly documented capabilities for pistachios and nuts. The presence of AI is not the differentiating factor: what matters is which categories it resolves, how it adapts and what evidence exists for an equivalent multivariable challenge.

SES	MULTISCAN	TOMRA	BÜHLER	
Proprietary hybrid, trainable AI	Advanced vision and SpinSort	AI and multispectral sensors; LUCAi/AI depending on model	Advanced optics and deep learning in specific models	Optical vision depending on
360° through rotation or multi-view	SpinSort 360°	Two sides / multiple angles depending on architecture	Depends on sorter and application	360° in certai
Natural, partially open, closed and mechanical	Published open/close sorting	Sorting and defects; the same opening taxonomy is not published	Sorts in-shell and shelled product; defects and sizes	Pistachio solu
Opening, size, shell, kernel, defects and destination	Quality, color, size, shape and open/close	Color, shape, size, composition, foreign material and defects	Stains, insects, mold, breakage, size and foreign material	Quality and s
Yes. Open detection path	No equivalent public evidence located	No equivalent public evidence located	No equivalent public evidence located	No equivalen
Yes. New classes, tolerances and varieties	Parameter configuration; equivalent autonomy not published	Adjustment/training depending on model; equivalent autonomy not published	Application-specific models; equivalent autonomy not published	Self-learning scope to be c

LUSION

ellent optical systems. SES's advantage is bringing visual coverage, multivariable understanding, anomaly detection, customer training and 9.6% in a complex configuration together on one platform.

9. WHAT EACH MANUFACTURER DOES AND HOW SES DIFFERS

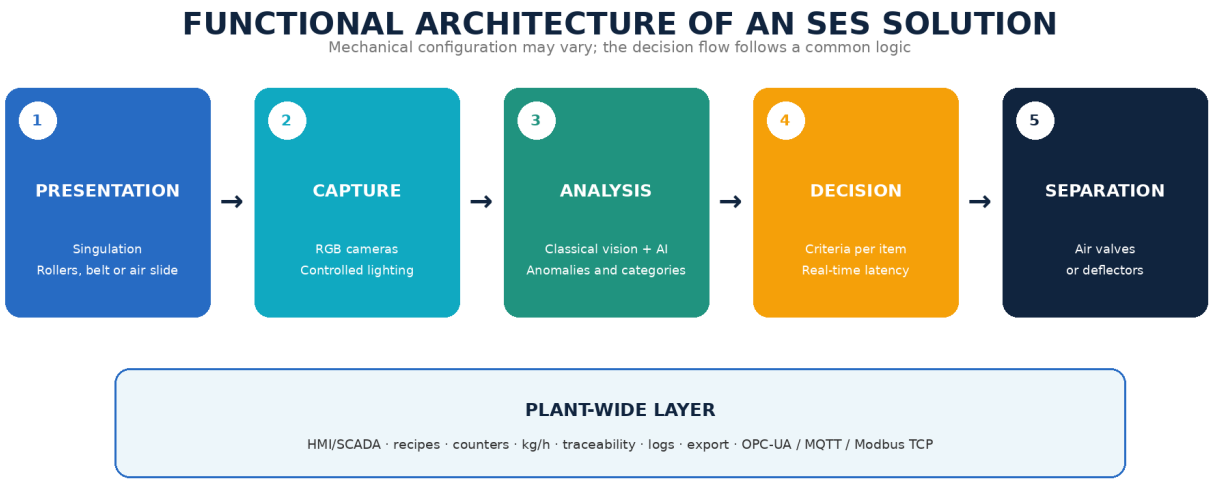
Comparison based on official documentation for pistachios and nuts.

MANUFACTURER	RELEVANT PUBLIC CAPABILITY	SES DIFFERENCE
MULTISCAN	S60SP for in-shell pistachios: sorting by external quality, color, size, shape and open/closed; SpinSort 360°.	SES extends the decision to partially open, mechanically opened, kernel color, severity, defects and commercial grades; it also incorporates open learning and customer training.
TOMRA	Solutions for pistachios and nuts using cameras, lasers, BSI+, AI and detection of foreign materials, mold, insect damage and stains.	SES focuses value on the customer-defined taxonomy and the ability to create new classes and tolerances without being limited to a catalog of predefined defects.
BÜHLER SORTEX	Sorts pistachios in-shell or shelled, raw or roasted; removes light or dark stains, insect damage, mold, shriveled or broken nuts, off-size product and foreign materials.	SES adds an open understanding of commercial criteria and retraining with customer samples, using an architecture designed to adapt intelligence to the plant.
RAYTEC VISION	Publishes optical solutions for pistachios and nuts; certain machines incorporate 360°, deep learning or self-learning.	SES provides its own evidence of multiclass performance, open category definition and a complete workflow for turning new anomalies into production decisions.

The conclusion is not that other brands lack AI. It is that no directly equivalent public evidence has been found for SES's combination of multivariable sorting, open learning, customer training and efficiency of up to 99.6% under a common protocol.

10. SES INDUSTRIAL ARCHITECTURE

Accuracy comes from controlling presentation, capture, analysis, tracking and ejection as a single system.



AI can only make sound decisions when it receives a stable image associated with the correct item. SES integrates presentation mechanics, industrial cameras, lighting, edge processing, individual tracking and pneumatic or mechanical actuation.

180 fps	50 ms	EDGE	360°
INDUSTRIAL CAPTURE	DOCUMENTED LATENCY	LOCAL DECISION	COVERAGE BY CONFIGURATION

THE MECHANICAL KEY

A crack that cannot be seen cannot be classified. That is why surface coverage and nut stability form part of the system's effective intelligence.

11. THE CUSTOMER TEACHES THE MACHINE

Quality criteria remain in the plant and can evolve with every crop.

SES turns the quality manager's knowledge into a digital recipe. Customers can create a class, change a tolerance, incorporate a variety or separate a new commercial destination using real samples and a controlled validation process.

1 DEFINE

What premium, standard, industrial or reject means.

2 CAPTURE

Real samples of openings, sizes, defects and varieties.

3 LABEL

Assign classes and severity levels with the customer's expert.

4 LEARN

Train or specialize the model.

5 VALIDATE

Test with product not used during learning.

6 DEPLOY

Activate the version with date, recipe and traceability.

EXAMPLES OF CHANGES IT CAN LEARN

- A variety with different geometry or color.
- A hairline crack considered acceptable by one buyer and a reject by another.
- An emerging crop defect.
- A new reprocessing category.
- A premium specification with zero tolerance for visible stains.

RESULT

The sorter ceases to be a closed machine and becomes a knowledge capability that evolves with the business.

12. WHAT SES CAN SORT IN PISTACHIOS

An open taxonomy that combines technical criteria and commercial grades.

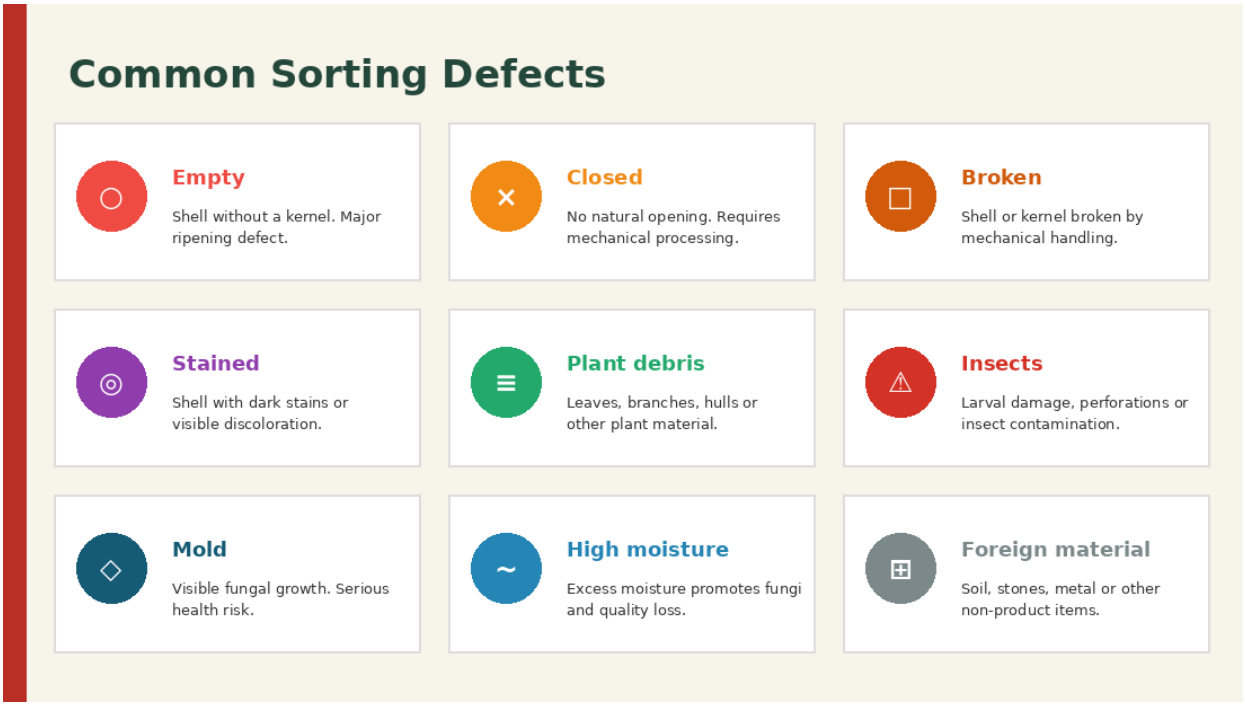


Figure 3. Common defects and contaminants in pistachio sorting.

DIMENSION	SORTABLE CRITERIA	POSSIBLE DECISION
Opening	Naturally open, partially open, closed, mechanically opened	Premium / process / industrial
Size	Extra-large, large, medium and small	Price, presentation and destination
Shell	Uniform cream, stained, dark or degraded	Acceptable / reprocessing / reject
Kernel	Green-yellow, uneven, oxidized or brown	Freshness and commercial quality
Integrity	Whole, minor crack, broken, split or empty	Grade or discard
Biological	Insect damage, visible mold, deterioration	Reject or specific control
Impurities	Hulls, leaves, branches, soil, stones, metal and others	Cleaning / safety / reject

SENSORY CONDITION

Moisture, aflatoxins or internal defects should not automatically be attributed to an RGB camera. They may require UV, NIR, multispectral imaging, X-rays, weight or density integrated into the same decision logic.

13. ECONOMIC AND OPERATIONAL IMPACT

Fewer false rejects, more premium product recovered and rapid adaptation to each buyer.

MORE VALUE RECOVERED

A premium pistachio should not be lost through inaccurate sorting. Reducing false rejects increases commercial yield.

LESS VARIABILITY

The same criteria are maintained across shifts, crops and operators.

MORE USEFUL CATEGORIES

The plant can separate premium, standard, industrial, reprocessing and reject grades according to its own criteria.

LESS DEPENDENCE

New varieties or defects are incorporated through training, without turning every change into a new machine.

ILLUSTRATIVE CALCULATION

500 T/YEAR PLANT

Reducing false rejects from 1.5% to 0.8% prevents the loss of approximately 3.5 tonnes of product. At €8/kg for premium product, the recovered value would be approximately €28,000 per year, before adding quality improvements and reduced reprocessing.

The figure must be recalculated using each plant's actual volume, price and rate. The main metric is yield: kilograms accepted and correctly valued per kilogram fed into the line.

14. THE SES ADVANTAGE IN PISTACHIOS

Superior intelligence because it understands, learns and sorts exactly what the customer needs.

The industry's leading manufacturers offer advanced optics and AI. SES stands apart through the complete combination it places at the plant's disposal:

SEES THE ENTIRE NUT

Reduces blind spots through rotation or multi-view capture.

UNDERSTANDS THE OPENING

Distinguishes states and context, not merely a light or dark line.

RECOGNIZES ANOMALIES

Detects deviations even when they do not yet have their own class.

LEARNS FROM THE CUSTOMER

Turns real samples into new categories and tolerances.

ACHIEVES UP TO 99.6%

Multiclass performance depending on SES configuration and protocol.

TURNS QUALITY INTO DATA

Records results, categories, recipes and batch traceability.

THE STATEMENT THAT SUMS UP SES

SES does more than separate open and closed pistachios. It understands what it sees, learns the customer's criteria and places every nut in the correct commercial grade.

SEE → UNDERSTAND → LEARN → SORT