Date Quality Assessment in Postharvest Processing

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Date Production in Oman

Oman

- 8th largest date producer in the world

Date Palm

- 7 million trees
- 250 varieties

Date Palm

- 82% total fruit crops
- 49% total agricultural land

Production

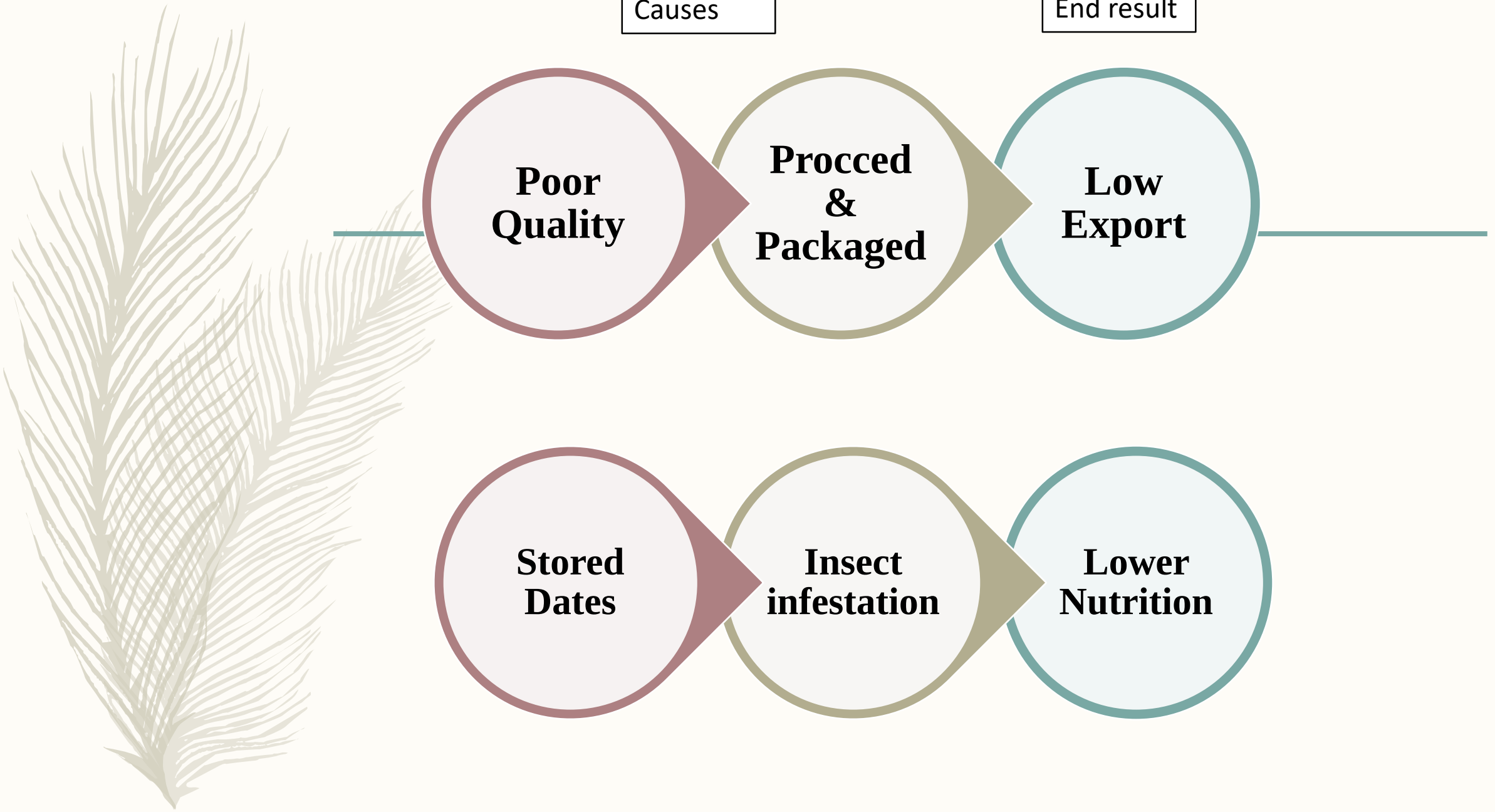
- 276,400 tones

Export

- 10,000 tones

Stored

- 60 -70%


Causes
End result
Poor Quality
Procced & Packaged
Low Export
Stored Dates
Insect infestation
Lower Nutrition

Date Quality

Standard grading based on physical properties

Size
10 pt

Color
20 pt

Shape
40 pt

Defects
30 pt

CODEX and U.S Standards for Grades of Dates

Date Quality (Defects)

Blemishes	abnormalities in surface appearance affecting an aggregate area greater than that of a circle 7 mm in diameter. (Scars, discoloration, sunburn, dark spots, blacknose or similar)
Damaged	dates affected by mashing and/or tearing of the flesh exposing the pit or to such an extent that it significantly detracts from the visual appearance of the date
Unripe Dates	Dates which may be light in weight, light in color, have shrivelled or little flesh or a decidedly rubbery texture
Un-pollinated Dates	Dates not pollinated as evidenced by thin flesh, immature characteristics
Dirt	Dates having embedded organic or inorganic material similar to dirt or sand in character and affecting an aggregate area greater than that of a circle 3 mm in diameter
Insects and mites	Dates damaged by insects or mites or contaminated by damage and contamination the presence of dead insects or mites, fragments of insects or mites or their excreta
Scouring	Breakdown of the sugars into alcohol and acetic acid by yeasts and bacteria
Mould	Presence of mould filaments visible to the naked eye
Decay	Dates that are in a state of decomposition and very objectionable in appearance.

Manual Inspection

- Laborious
- Inconstant
- Time consuming
- Costly

Date quality effects during harvesting and processing

Al Mabsili Date Stripping

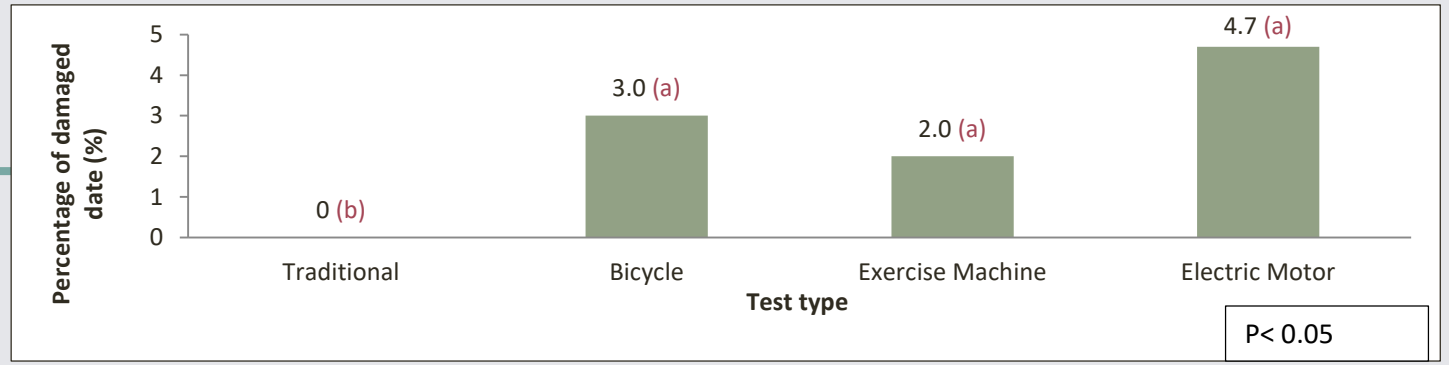
Traditional –
Manual Stripping

Mechanical Stripping

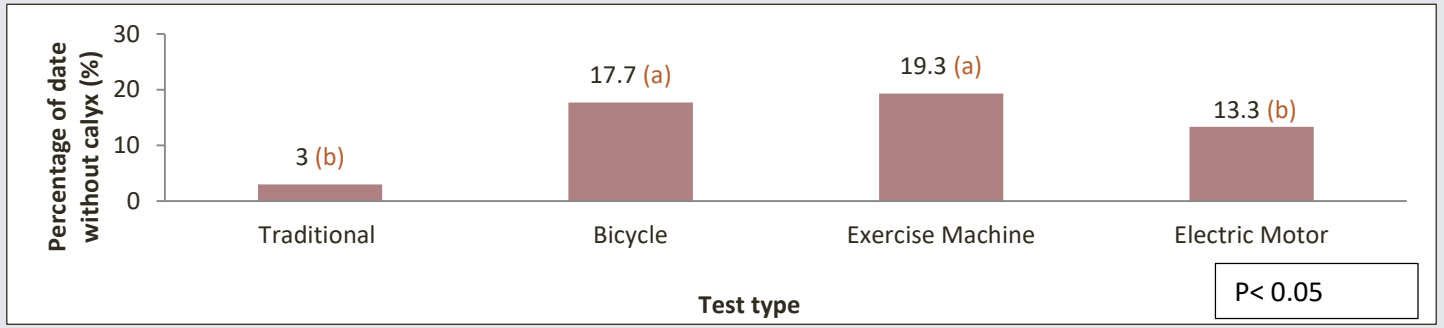
Date damage – postharvest handling

- Damage by bruices and scratches

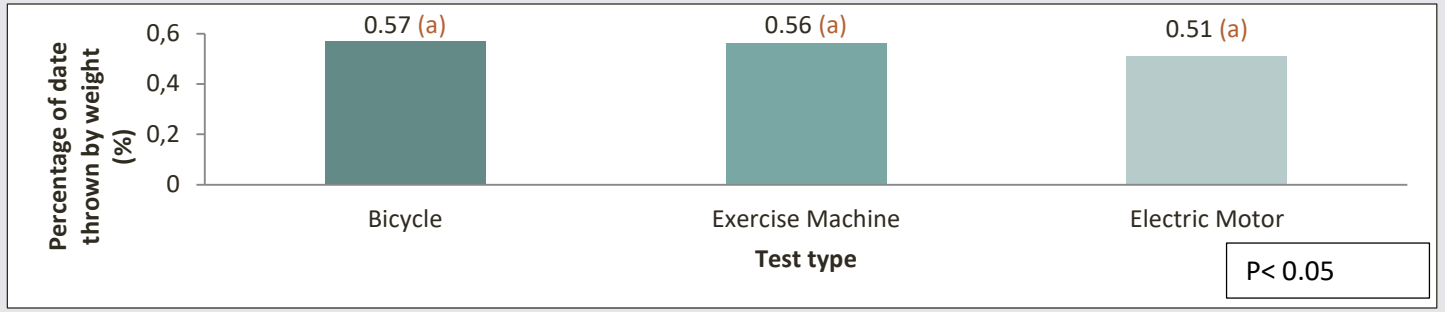
100 Sample



- Date without calyx



- Date thrown by the machine



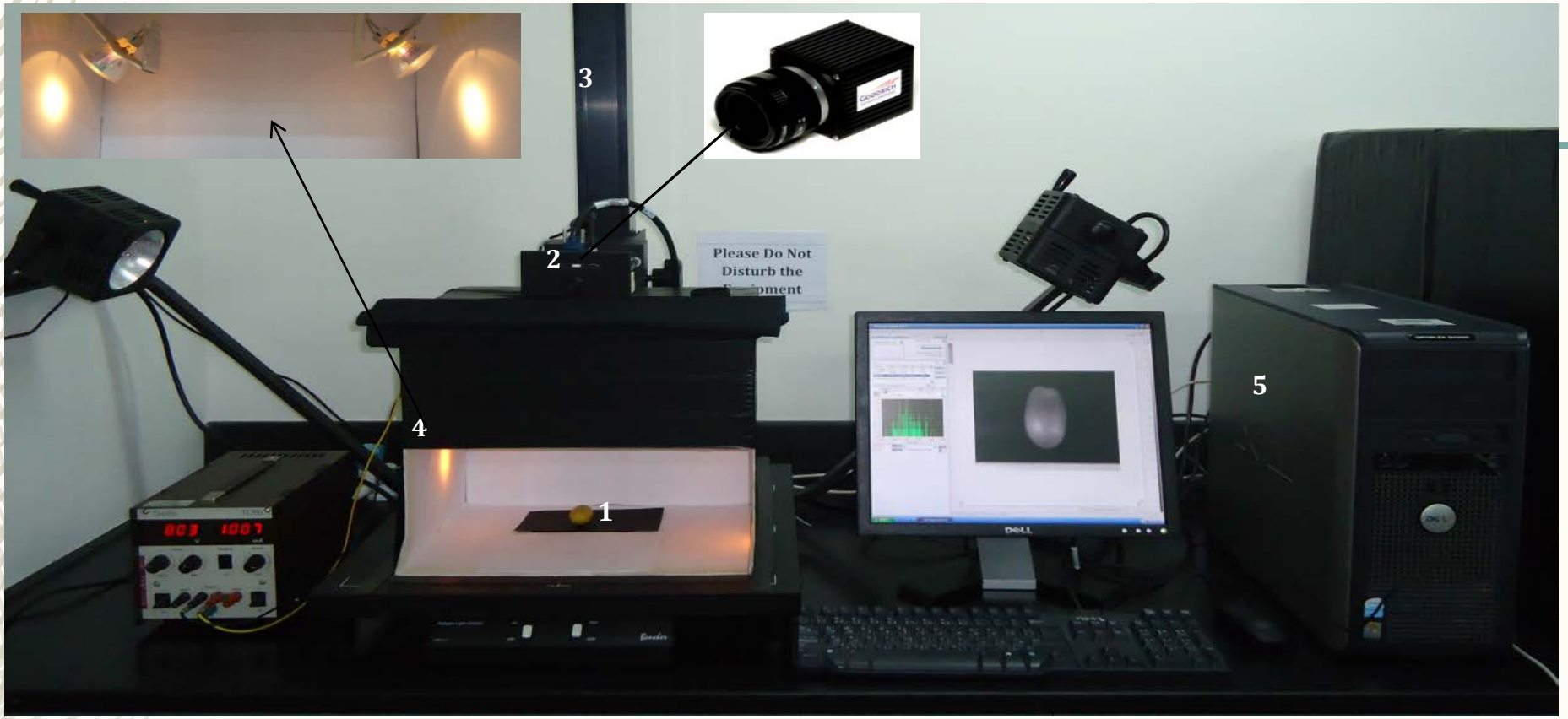
Imaging techniques to evaluate defects

Detect surface cracks on dates and classify them
(Color Imaging)

Classify dates based on hardness
(Monochrome Imaging)

Detect internal infestations in dates by saw-toothed beetle
(X-ray Imaging)

Inspection through computer visions



The *NIR/RGB/Monochrome* imaging systems

1. Sample platform, 2. NIR/RGB/Monochrome camera, 3. B&H mounting stand,
4. Illumination, 5. Image acquisition system

Algorithm using RGB color imaging technique to classify defects

Technique to detect surface cracks on dates and classify them depending on the amount of cracks

High Crack

Low Crack

No Crack

Surface Cracks

-Tiny breaks

- Transverse

- Longitudinal

- Irregular

differ in varieties

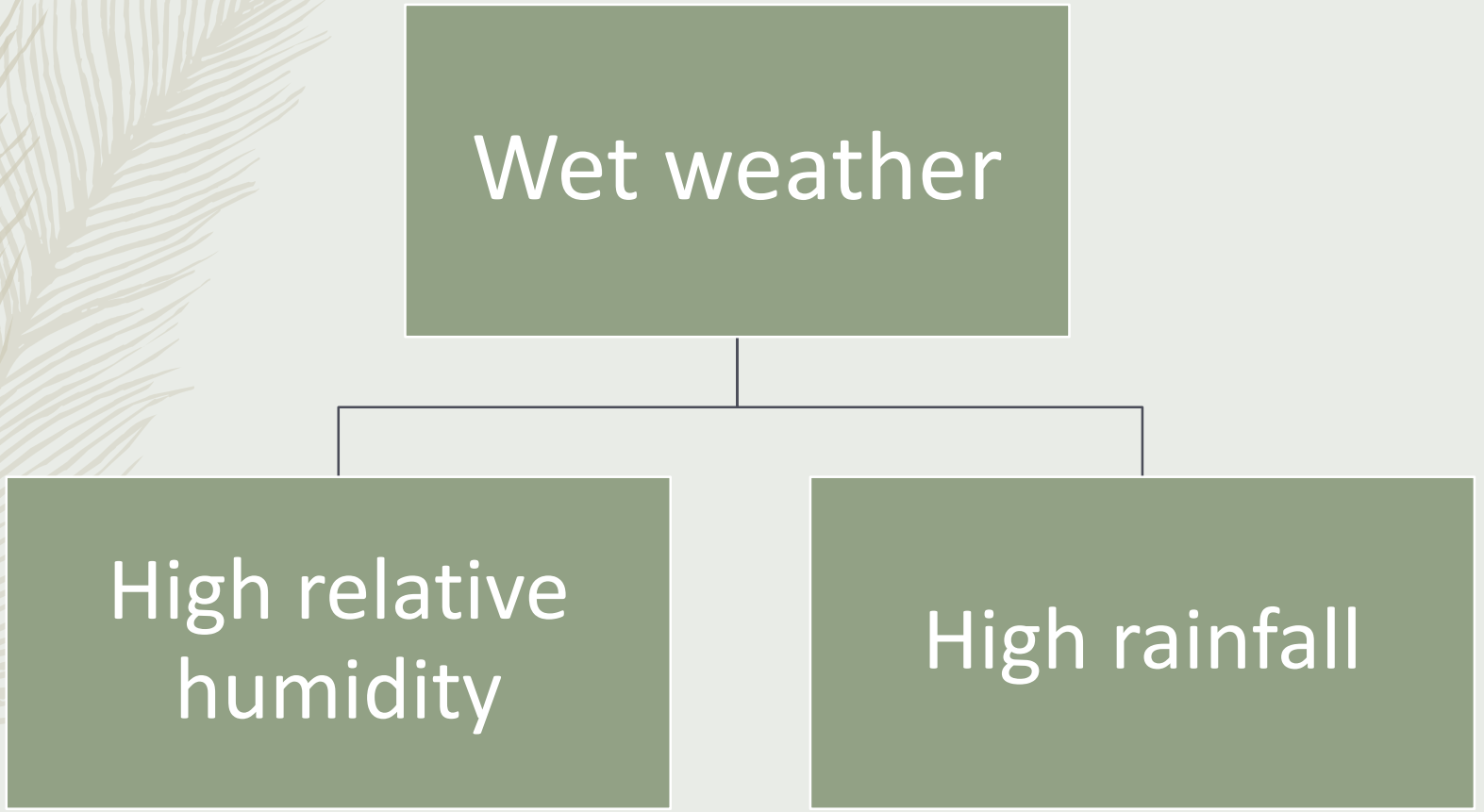
How do cracks occur?

1. Date Mite (Goubar Mite)
   - Before harvest
   - Make cuts and feed on the fruit
   - Covers the fruit with a web

Goubar Mite

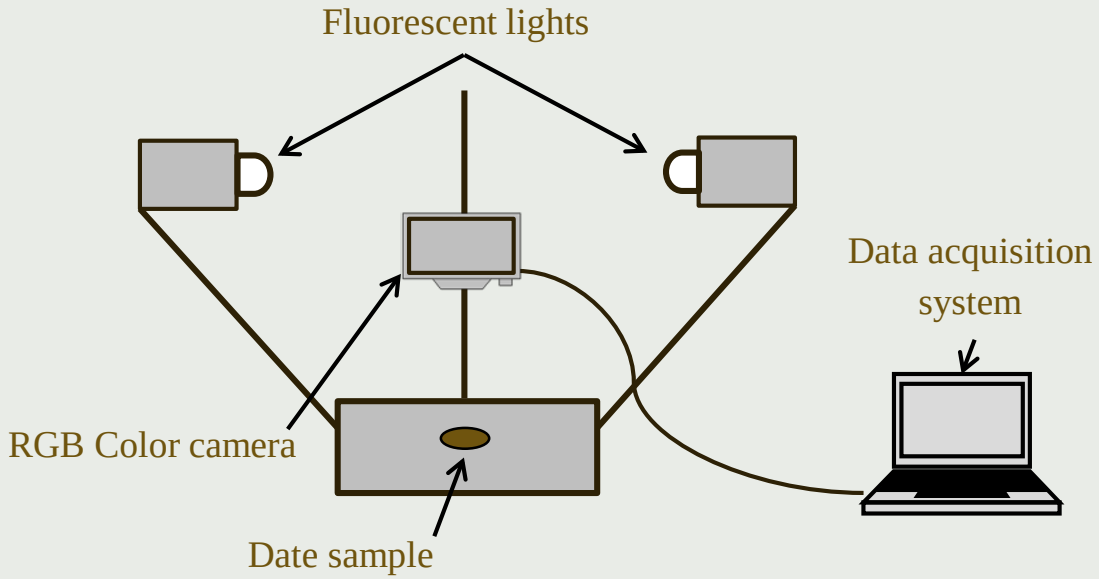
Affected Dates

How do cracks occur?



Method using RGB Imaging technique

- “Khalas” variety
- 315 sample from 2 date factories
- Color Camera (RGB)

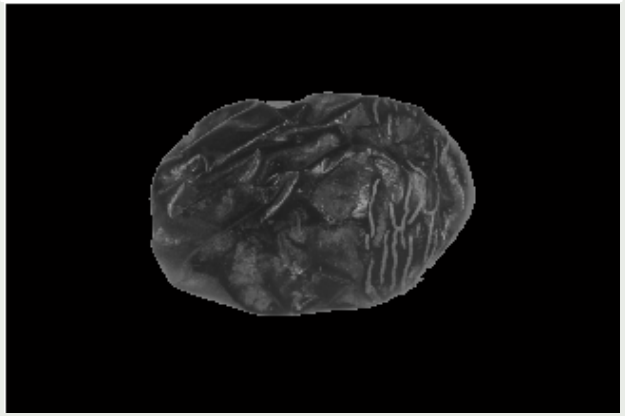


Method using RGB imaging technique

- Image processing in Matlab software:
  - Image Segmentation

RGB Image

Segmented Image



RGB Image

Threshold Area

Mask Area

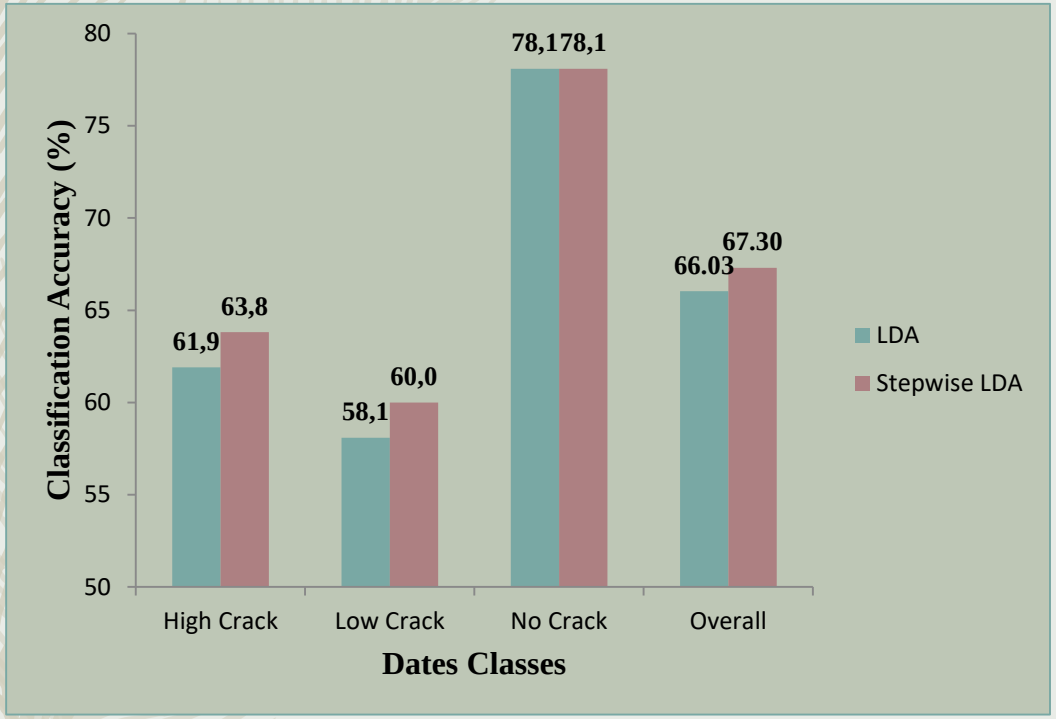
Method using RGB imaging technique

- Image processing in Matlab software:
  - Image Segmentation
  - Features Extraction
    - Gray Intensity
    - Red , Green and Blue Intensities
    - Hue, Saturation, Value Intensities
    - **Threshold Area:** The area extracted by Threshold
    - **Masks Area:** The area extracted by combining HSV masks
    - **Threshold %:** The percentage of the area extracted by Threshold over the total area of the object
    - **Masks %:** The percentage of the area extracted by combining HSV masks over the total area of the object

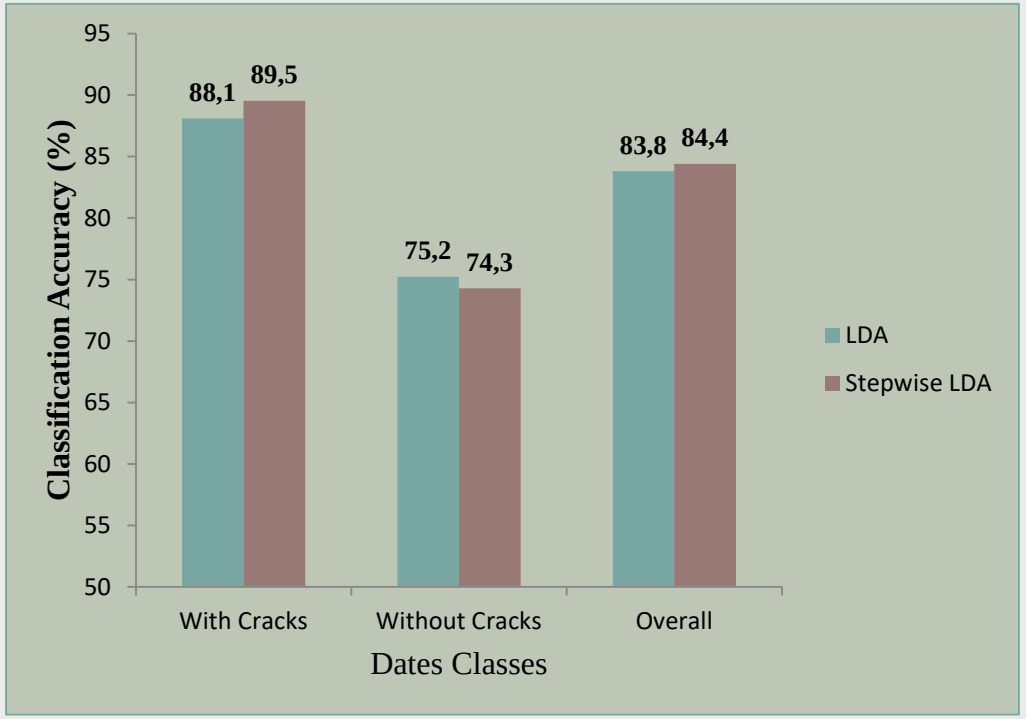
Method using RGB imaging technique

- Statistical Analysis in SPSS Software
- Two cases:
  - 3 classes (high crack, low crack, no crack)
  - 2 classes (with cracks, without cracks)
- Classification Model
  - Linear Discriminant Analysis (LDA)
  - Stepwise LDA

Results



Three classes model



Two classes model

Conclusions

- The developed algorithm was able to classify the cracked dates in 3 classes with accuracy of **67.3 %**
- The developed algorithm was able to recognize the cracked dates from healthy dates with accuracy of **84.4%**

Using monochrome imaging technique to classify date

Develop an algorithm using monochrome imaging technique to classify date based on hardness

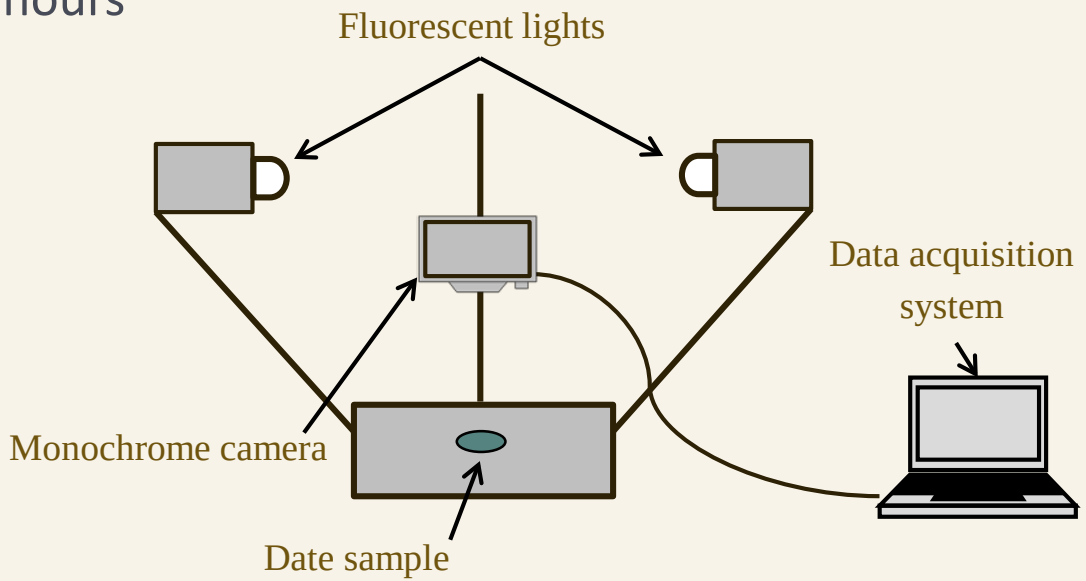
(a)Soft Date

(b) Semi-hard Date

(c) Hard Date

Using monochrome imaging technique to classify date

- “Fardh” variety
- 1800 sample (60/class) from 3 date factories
- Hardness analysis using Texture Profile analysis (TPA)
- Moisture content in 105°C for 24 hours
- Monochrome Camera



Using monochrome imaging technique to classify date

Monochrome Image

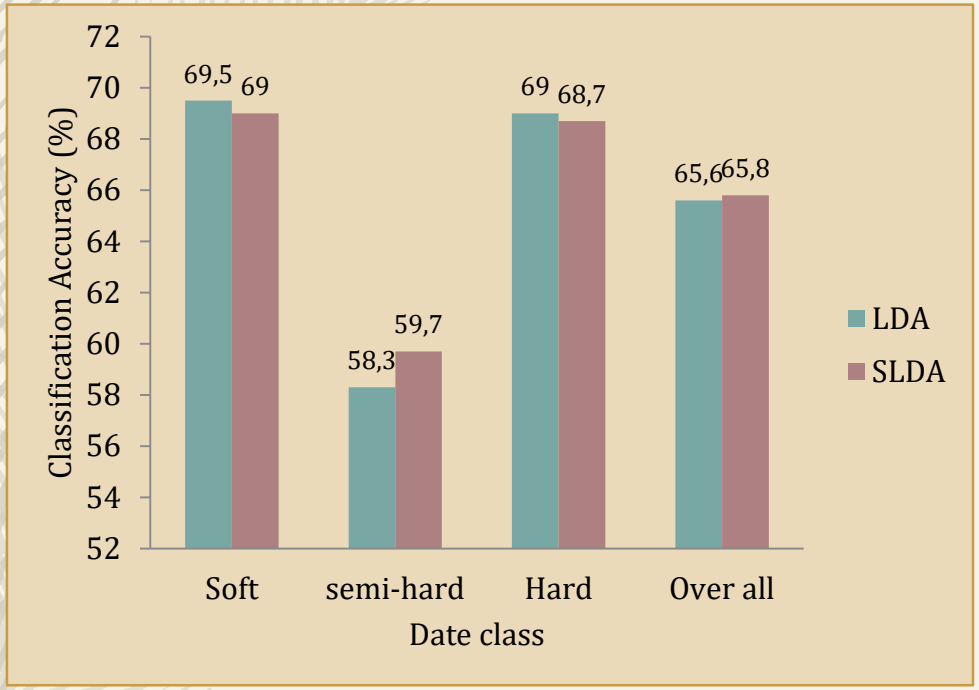
Segmented Image

- Image processing in Matlab software:
  - Image Segmentation
  - Features Extraction
    - **Histogram Features:** Mean gray value, Standard deviation, Variance, Smoothness, Eccentricity, Solidity and Extent
    - **Texture Features:** Contrast, Correlation, Energy, Homogeneity, Maximum, Probability, Entropy, Cluster Prominence, Cluster Shade and Dissimilarity

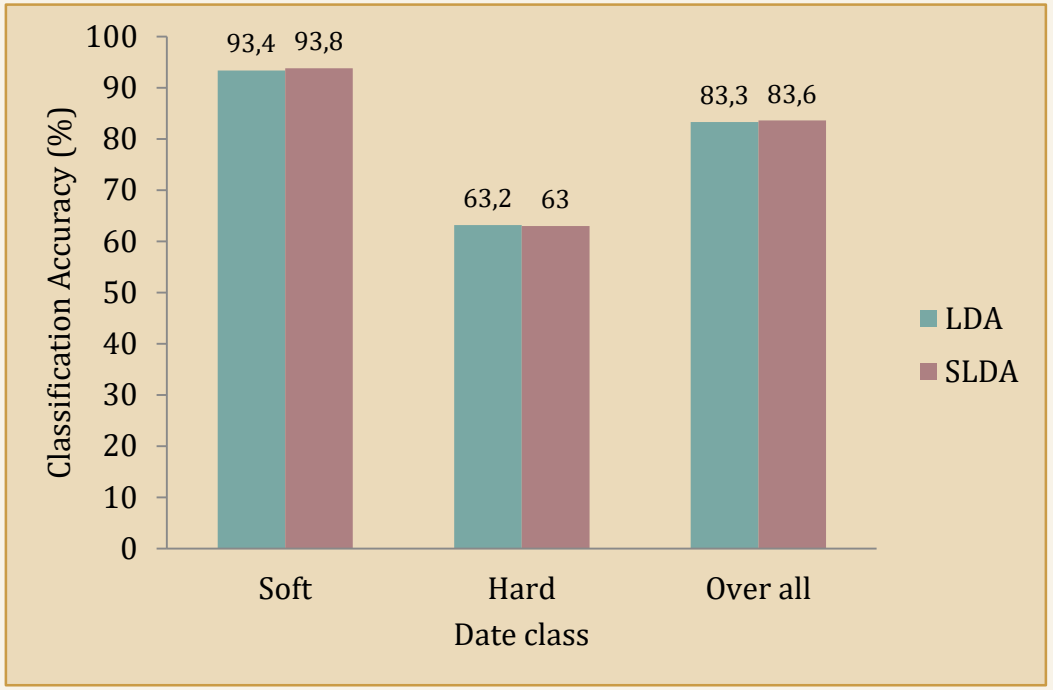
Using monochrome imaging technique to classify date

- Statistical Analysis in SPSS Software:
- Three cases
  - 3 classes (Soft, Semi Hard, Hard)
  - 2 classes (Soft, Hard)
- Classification Model
  - Linear Discriminant Analysis (LDA)
  - Stepwise LDA

Results



Three classes model



Two classes model

Conclusions

- The developed algorithm was able to classify the cracked dates in 3 classes with accuracy of **60 – 76 %**

- The developed algorithm was able to recognize the hard dates from soft dates with accuracy of **83 – 86 %**

X-ray imaging technique to detect internal infestations

Determine the potential of X-ray imaging technique to detect internal infestations by saw-toothed beetle *Oryzaephilus Surinamensis* in dates

Egg

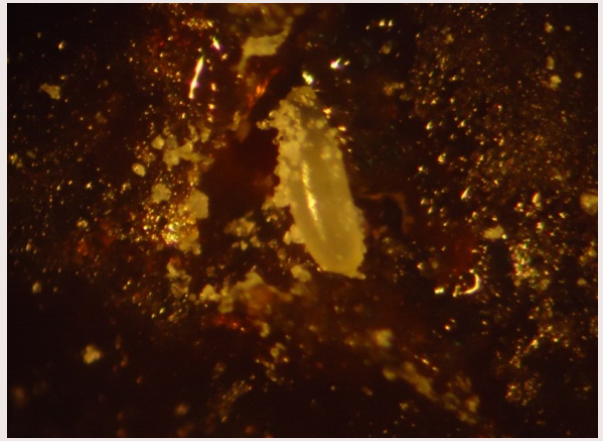
Larvae

Pupae

Adult

X-ray imaging technique to detect internal infestations

- 40 date samples of “Fardh” variety
- *Oryzaephilus surinamensis* eggs
- Infested dates (30 ± 1˚ C, 70 ± 5 R.H & 0 LS)
- 1, 20, 25 and 27 days (egg, larvae, pupa and adult respectively)



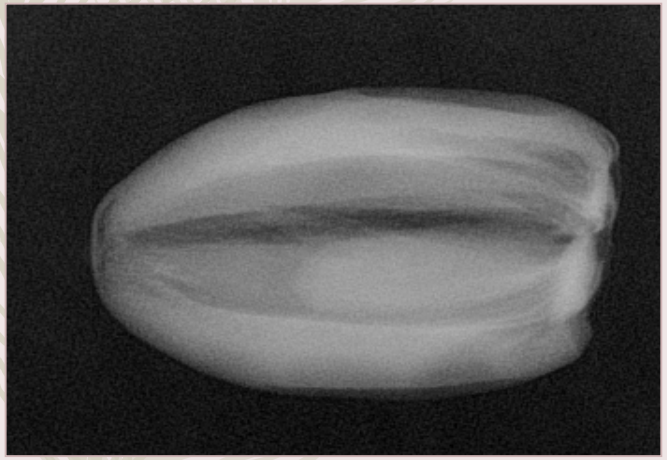
Artificially infested dates under the microscope

X-ray imaging technique to detect internal infestations

- X-ray machine, SQUH
- Image resolution (512 x 512)

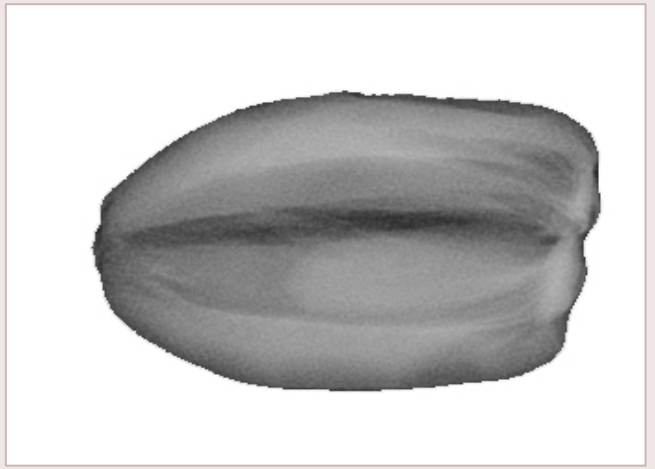
X-ray imaging technique to detect internal infestations

- Image processing in Matlab software:
  - Image Segmentation



Original X-ray image

Simple Threshold image



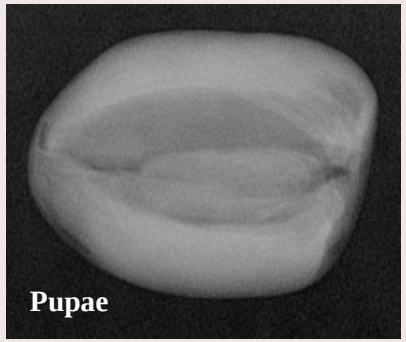
Segmented image

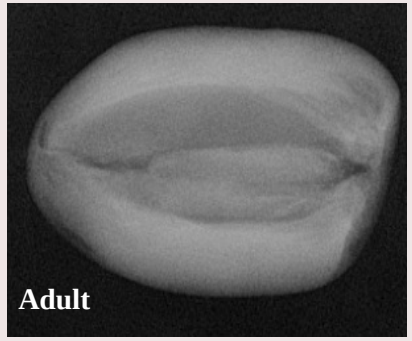
X-ray imaging technique to detect internal infestations

- Feature Extraction
  - **Histogram features:** Total gray value, Mean gray value, Standard deviation, Area of kernel, Minimum Intensity, H1-H23 & H8-H17 subdivided
  - **Textural features:** Contrast (GLCM), Energy (GLCM), Mean (GLCM), Variance (GLCM), Maximum probability (GLCM), Entropy (GLCM)
- Statistical Analysis in SPSS Software:

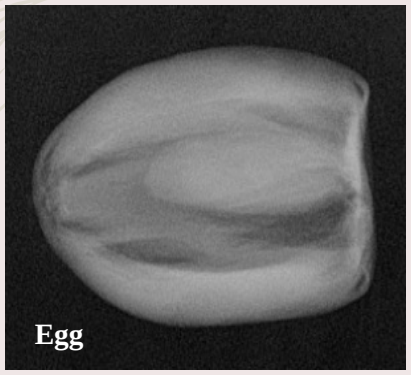
  Classification Models

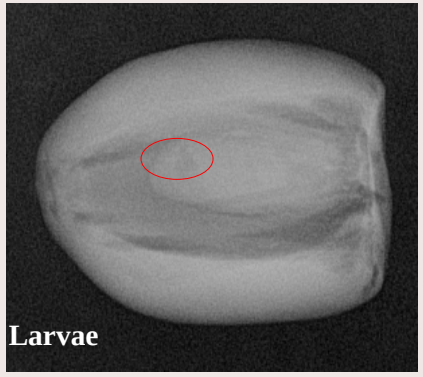
Results

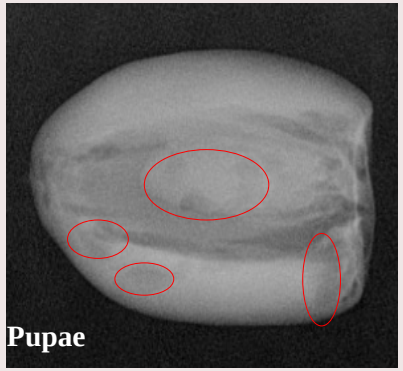


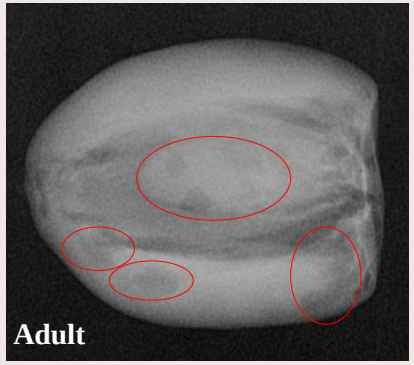


Sample (1)



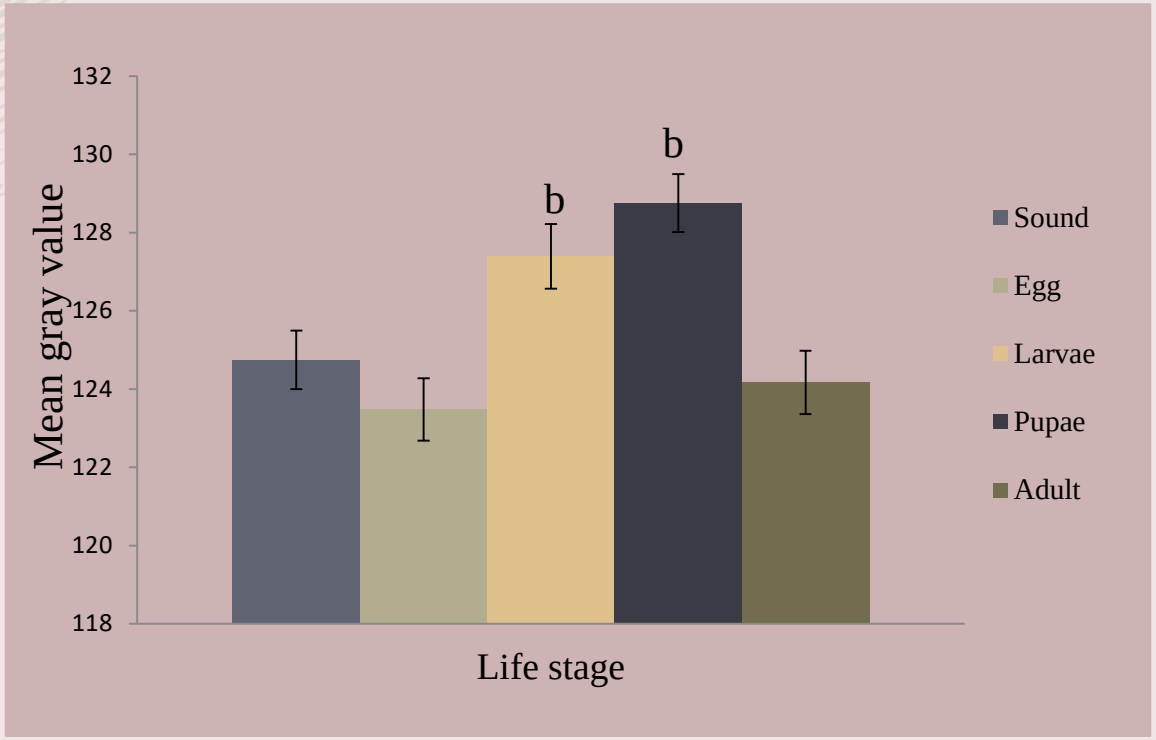






Sample (2)

Results


132
130
128
126
124
122
120
118
Mean gray value
b
b
Life stage
Sound
Egg
Larvae
Pupae
Adult

Results

n = 16

	Groups	Predicted Group Membership					Total
		Sound	Egg	Larvae	Pupae	Adult	
Original	Sound	**75.0**	6.3	12.5	.0	6.3	100.0
	Egg	12.5	**81.3**	.0	.0	6.3	100.0
	Larvae	18.8	.0	**68.8**	12.5	.0	100.0
	Pupae	.0	.0	18.8	**81.3**	.0	100.0
	Adult	.0	6.3	.0	.0	**93.8**	100.0

80.0% of original grouped cases were correctly classified

Conclusions

- 16 /40 successfully reached the mature stage
- No noticeable visual appearance of the insect infestation in the X-ray image of infested dates.
- Misclassification of more than 10%

Thank You!