RTB Breeding

Activity n°3 :

Evaluation of acceptability thresholds of key quality traits for the different RTB food products

Online modules n°5 and 6:

- Calculation of acceptability thresholds
- Hybrid Selection

Deuscher Zoé

Adinsi Laurent

& Bugaud Christophe

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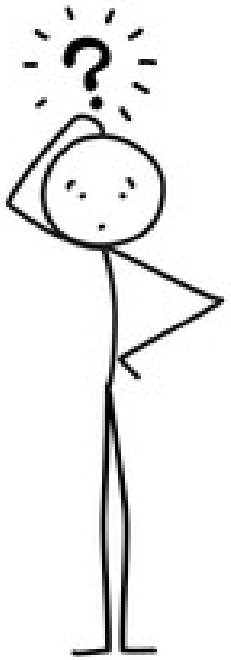


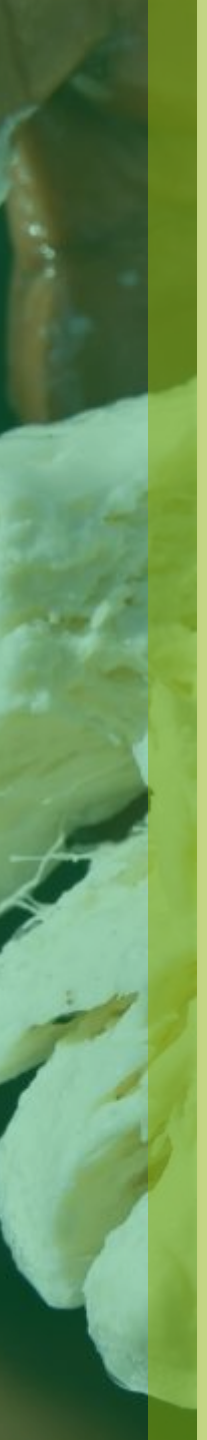
How to calculate acceptability thresholds?

I. Hedonic test results

II. Descriptive test results

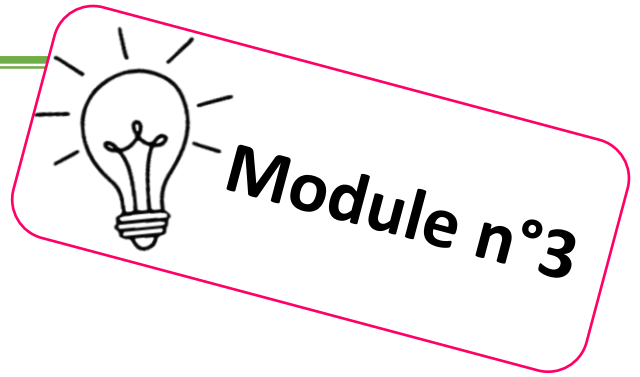
III. Calculation of acceptability thresholds

In this tutorial you'll learn how to format and process your data in Excel to calculate acceptability thresholds



RTB Breeding

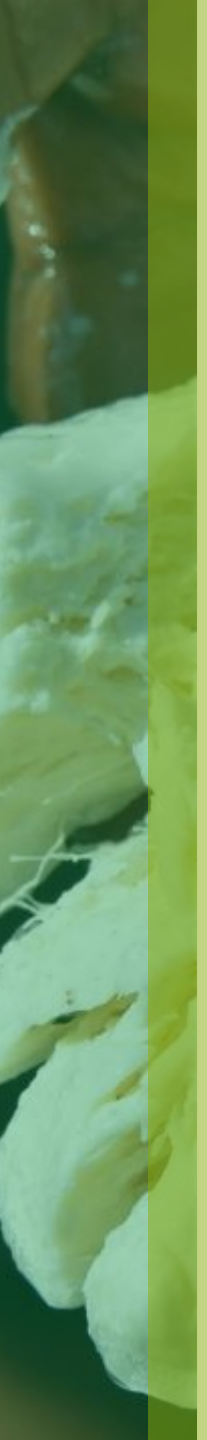
I. Hedonic test results



Reminder

- Hedonic test→ consumer acceptability and/or preferences
- Minimum 100 consumers
- Maximum 6 samples per tasting
- Different types of questions: to calculate thresholds, JAR test types are required

Geneviève FLIEDEL, Isabelle MARAVAL, Aurélie BECHOFF, Eglantine FAUVELLE, (2022). *Guidance for Consumer Testing Data Analysis & Reporting - Supplement to Step 4. Understanding the Drivers of Trait Preferences and the Development of Multi-user RTB Product Profiles, WP1, Step 4.* Montpellier, France: RTBfoods Methodological Report, 50 p. https://doi.org/10.18167/agritrop/00660



I. Hedonic test results

RTB Breeding

- Just about right (JAR) scale : determine the **optimum level of intensity** as perceived by the consumers for **some important sensory quality characteristics** of the product samples
- Consumers were asked to give their perception of the sensory characteristics of each product sample, by using a 3-point JAR scale :
  - 1 = “Too low “or “Too weak” or “Not enough”
  - 2 = “Just About Right”
  - 3 = “Too high” or “Too strong or “Too much”
- How to do it? → **Module n°3**

2. JAR-TEST: compared to your ideal

How do you perceive the colour of this boiled plantain?

Not yellow enough	As I like	Too yellow
☐	☐	☐

How do you perceive the firmness of this boiled plantain?

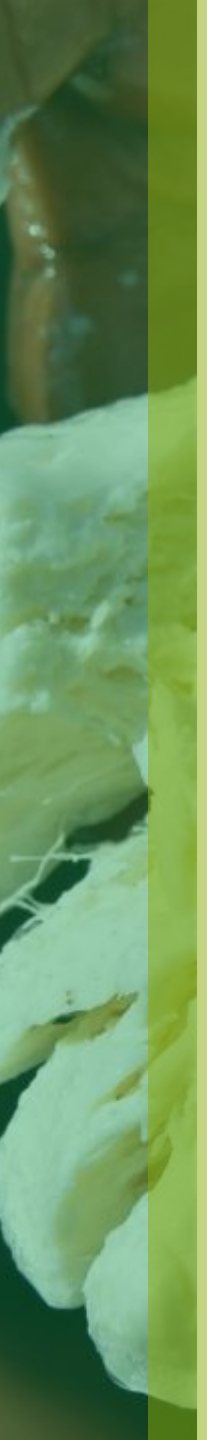
Ask the taster to taste and evaluate the consistency of the plantain

Not firm enough	As I like	Too firm
☐	☐	☐

How do you perceive the wetness of this boiled plantain?

Ask the taster to taste and evaluate the wetness of the plantain

Not wet enough	As I like	Too wet
☐	☐	☐



I. Hedonic test results - *Data tables*

RTB Breeding

After performing the consumer test : Enter **raw data into a Excel table** :

- Each **row** corresponds to a **consumer** (encoded with a number, never a name)
- The **columns** correspond to the answers to the **various questions** in the questionnaire

answers to the various questions in the 322 sample

answers to the various questions in the 106 sample

N°	Gender [1] W [2] M	Nationality [1] French [2] Other	Age	322_Overall liking [1] Extremely unpleasant [2] Very unpleasant [3] Unpleasant [4] A little unpleasant [5] Neither pleasant nor unpleasant [6] A little pleasant [7] Pleasant [8]Very pleasant [9] Extremely pleasant	322_JAR test_Firmness [1]Not firm enough [2] Just about right [3] Too firm	322_JAR test_Sweetness [1]Not sweet enough [2] Just about right [3] Too sweet	322_JAR test_Acidity [1]Not acid enough [2] Just about right [3] Too acid	106_Overall liking [1] Extremely unpleasant [2] Very unpleasant [3] Unpleasant [4] A little unpleasant [5] Neither pleasant nor unpleasant [6] A little pleasant [7] Pleasant [8]Very pleasant [9] Extremely pleasant	106_JAR test_Firmness [1]Not firm enough [2] Just about right [3] Too firm	106_JAR test_Sweetness [1]Not sweet enough [2] Just about right [3] Too sweet	106_JAR test_Acidity [1]Not acid enough [2] Just about right [3] Too acid
1	1	2	26	7	3	1	2	7	2	3	3
2	2	2	23	6	3	2	1	7	2	2	2
3	2	1	52	5	3	3	2	5	3	2	3
4	1	1	54	3	3	2	2	8	3	2	2
5	2	1	44	7	2	3	1	5	1	1	1
6	1	1	35	4	3	3	2	4	2	2	2
7	2	1	46	6	2	3	2	6	2	2	2

- Cautions : Please note that **not all** consumers tasted the **samples in the same order**, so don't make any mistakes when entering the results

I. Hedonic test results - *Data tables*

RTB Breeding

Simplify table : Gather **just the JAR results** by sensory attributes :

- First column → number of consumers (equivalent to the table rows)
- Next columns → correspond to the answers to the JAR questions for each descriptor in each product sample studied

JAR responses for the firmness of the various samples

JAR responses for the sweetness of the various samples

N°	322_JAR test_Firmness [1]Not firm enough [2] Just about right [3] Too firm	106_JAR test_Firmness [1]Not firm enough [2] Just about right [3] Too firm	543_JAR test_Firmness [1]Not firm enough [2] Just about right [3] Too firm	207_JAR test_Firmness [1]Not firm enough [2] Just about right [3] Too firm	159_JAR test_Firmness [1]Not firm enough [2] Just about right [3] Too firm	414_JAR test_Firmness [1]Not firm enough [2] Just about right [3] Too firm	322_JAR test_Sweetness [1]Not sweet enough [2] Just about right [3] Too sweet	106_JAR test_Sweetness [1]Not sweet enough [2] Just about right [3] Too sweet	543_JAR test_Sweetness [1]Not sweet enough [2] Just about right [3] Too sweet	207_JAR test_Sweetness [1]Not sweet enough [2] Just about right [3] Too sweet	159_JAR test_Sweetness [1]Not sweet enough [2] Just about right [3] Too sweet
1	3	2	3	3	2	1	1	3	1	2	3
2	3	2	2	2	1	1	3	2	2	2	2
3	3	3	2	3	2	2	2	2	3	2	3
4	3	3	2	2	2	2	1	2	2	3	2
5	2	1	1	1	1	1	1	1	3	2	1
6	3	2	2	2	2	2	1	2	3	2	2
7	2	2	2	2	1	2	2	2	3	2	2
8	3	2	3	3	2	2	3	3	2	1	3
9	2	2	1	2	1	2	2	1	3	2	2
10	3	2	3	3	2	2	2	3	3	1	3
11	3	2	1	1	1	2	1	1	3	3	1
12	3	3	3	2	2	2	3	3	2	2	2
13	2	3	3	2	2	1	3	3	2	1	2
14	3	2	2	2	1	2	1	2	2	1	2
15	2	1	1	1	1	1	2	1	3	3	1

I. Hedonic test results - *Data tables*

RTB Breeding

Create a table with only the JAR results : gather the JAR results of the different samples for the same descriptor in a single column

N°	322_JAR test_Firmness [1]Not firm enough [2] Just about right [3] Too firm	106_JAR test_Firmness [1]Not firm enough [2] Just about right [3] Too firm	543_JAR test_Firmness [1]Not firm enough [2] Just about right [3] Too firm	207_JAR test_Firmness [1]Not firm enough [2] Just about right [3] Too firm	159_JAR test_Firmness [1]Not firm enough [2] Just about right [3] Too firm	414_JAR test_Firmness [1]Not firm enough [2] Just about right [3] Too firm
1	3	2	3	3	2	1
2	3	2	2	2	1	1
3	3	3	2	3	2	2
4	3	3	2	2	2	2
5	2	1	1	1	1	1
6	3	2	2	2	2	2
7	2	2	2	2	1	2
8	3	2	3	3	2	2
9	2	2	1	2	1	2
10	3	2	3	3	2	2
11	3	2	1	1	1	2
12	3	3	3	2	2	2
13	2	3	3	2	2	1
14	3	2	2	2	1	2
15	2	1	1	1	1	1

N° of consummers	Samples	JAR test_Firmness [1]Not firm enough [2] Just about right [3] Too firm
1	322	3
2	322	3
3	322	3
4	322	3
5	322	2
6	322	3
7	322	2
8	322	3
9	322	2
10	322	3
11	322	3
12	322	3
13	322	2
14	322	3
15	322	2
1	106	2
2	106	2
3	106	3
4	106	3
5	106	1
6	106	2
7	106	2
8	106	2
9	106	2
10	106	2
11	106	2
12	106	3
13	106	3
14	106	2
15	106	1
1	543	3
2	543	2
3	543	2
4	543	2
5	543	1
6	543	2
7	543	2
8	543	3

I. Hedonic test results - *Pivot Table*

RTB Breeding

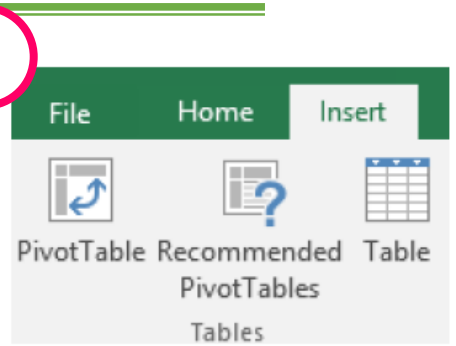
1. Select the dataset “JAR data” you want to create a Pivot Table from (previous table)

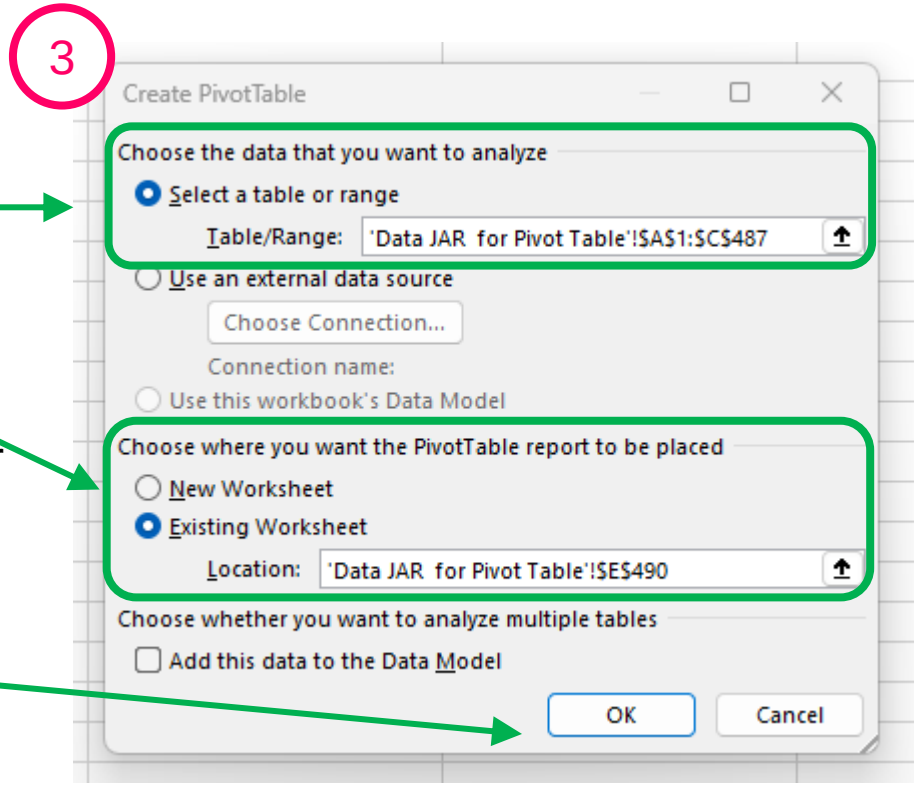
2. Select in Excel, **Insert** > **PivotTable**

3. Under **Choose the data that you want to analyse**, select **Table/Range** and select your excel table

- Under **Choose where you want the PivotTable report to be placed**, select a **New Worksheet** or **Existing Worksheet,** as you prefer

- Select **OK**





I. Hedonic test results - *Pivot Table*

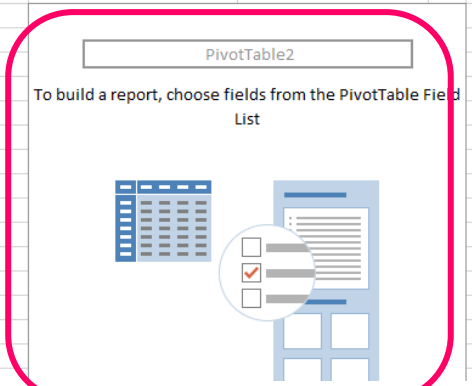
RTB Breeding

This is what appears after validating the creation of the pivot table:

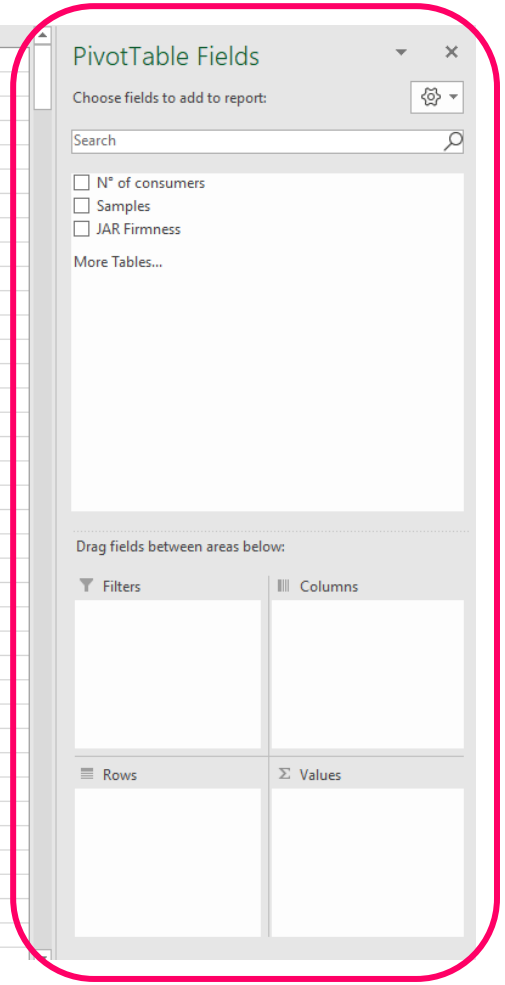
Your initial table

N° of consumers	Samples	JAR Firmness
1	322	3
2	322	3
3	322	3
4	322	3
5	322	2
6	322	3
7	322	2
8	322	3
9	322	2
10	322	3
11	322	3
12	322	3
13	322	2
14	322	3
15	322	2
16	322	2
17	322	2
18	322	2
19	322	2
20	322	3
21	322	3
22	322	3
23	322	3
24	322	1
25	322	3
26	322	3
27	322	3
28	322	3
29	322	2
30	322	2
31	322	3
32	322	2
33	322	3
34	322	3
35	322	2
36	322	3

Your futur pivot table

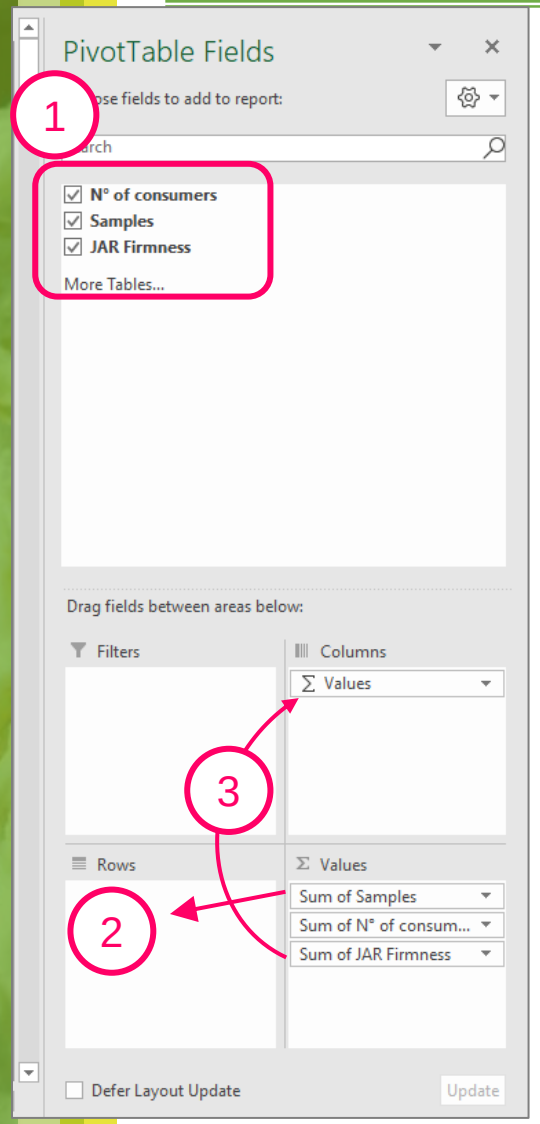


You can modify the design of the pivot table by adding or rearranging fields here



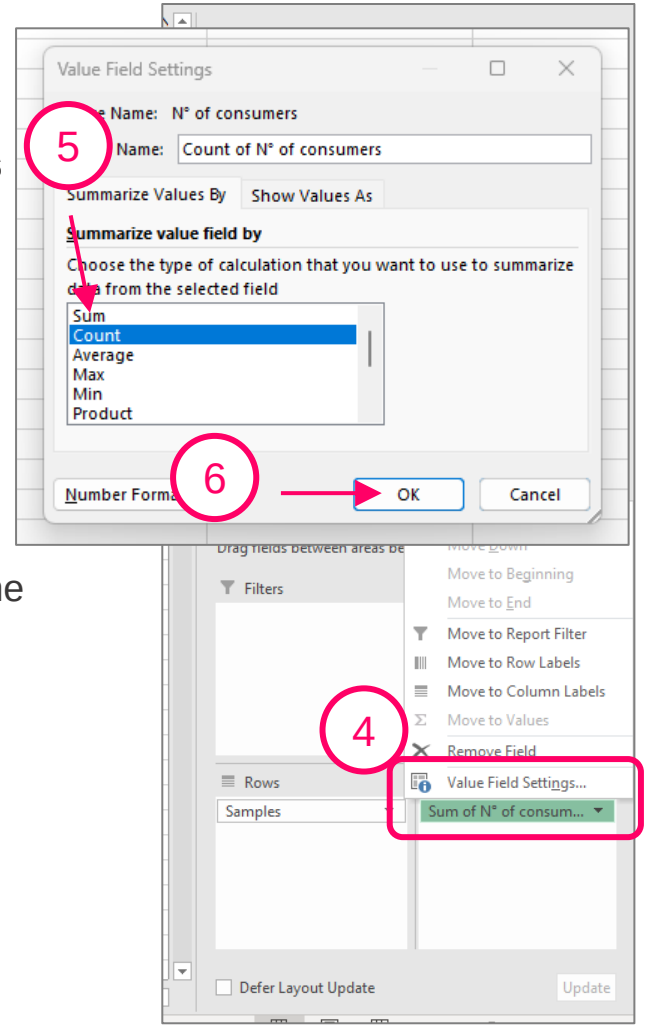
I. Hedonic test results - *Pivot Table*

RTB Breeding



In PivotTable fields:

1. Check boxes of **N° of consumers, Samples** and **JAR Firmness**
2. In the **Values** section > Move **Sum of samples** to the **Rows** box, label becomes “Samples”
3. In the **Values** section > Move **Sum of JAR Firmness** to the **Columns** section, the label becomes “**JAR Firmness”**
4. Leave sum of **N° of consumers** in the **Values** section. Click on the **arrow next to Sum of N° of consumers** > **Value field settings**
5. A new window appears : select **Count.**
6. Click OK. The label becomes « Count of N° of consumers »



I. Hedonic test results - *Pivot Table*

RTB Breeding

This is the excel sheet you should now have, with the pivot table in the center.

N° of consumers	Samples	JAR Firmness
1	322	3
2	322	3
3	322	3
4	322	3
5	322	2
6	322	3
7	322	2
8	322	3
9	322	2
10	322	3
11	322	3
12	322	3
13	322	2
14	322	3
15	322	2
16	322	2
17	322	2
18	322	2
19	322	2
20	322	3
21	322	3
22	322	3
23	322	3
24	322	1
25	322	3
26	322	3
27	322	3
28	322	3
29	322	2
30	322	2
31	322	3
32	322	2
33	322	3
34	322	3
35	322	2
36	322	3
37	322	3

Count of N° of consumers	Column Labels			
Row Labels	1	2	3	Grand Total
106	11	52	18	81
159	42	38	1	81
207	25	44	12	81
322	2	36	43	81
414	44	36	1	81
543	22	46	13	81
Grand Total	146	252	88	486

PivotTable Fields

Choose fields to add to report:

Search

- N° of consumers
- Samples
- JAR Firmness

More Tables...

Drag fields between areas below:

Filters

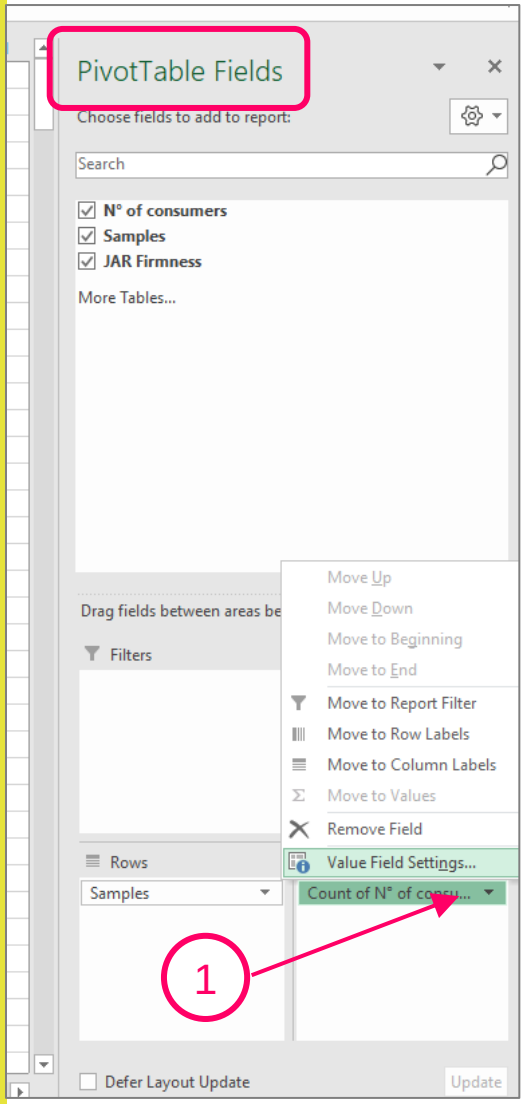
Columns: JAR Firmness

Rows: Samples

Values: Count of N° of consu...

I. Hedonic test results - *Pivot Table*

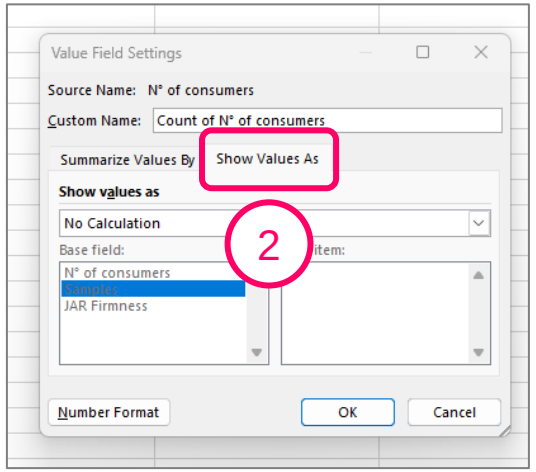
RTB Breeding

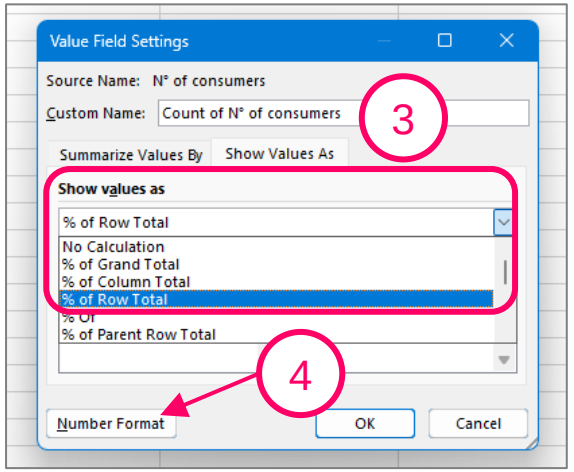


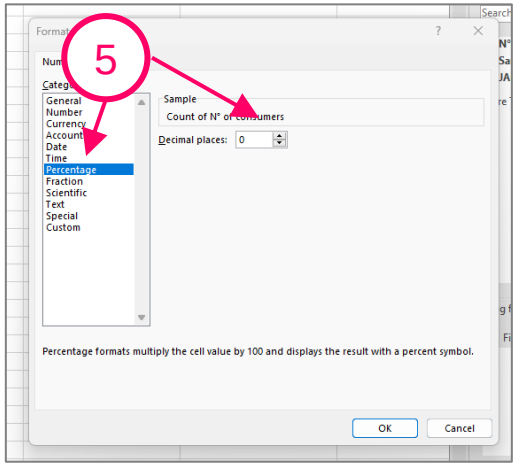
1. PivotTables Fields > **Values** > click on the arrow next to Count of N° of Consumers **> Value Field settings**
2. In the window that opens go to **Show Values As**
3. In the **Show Values as** drop-down menu, select **% of Row Total**
4. Click on **Number Format**
5. In the new windows : click on **Percenta**
6. The table is now in percentage

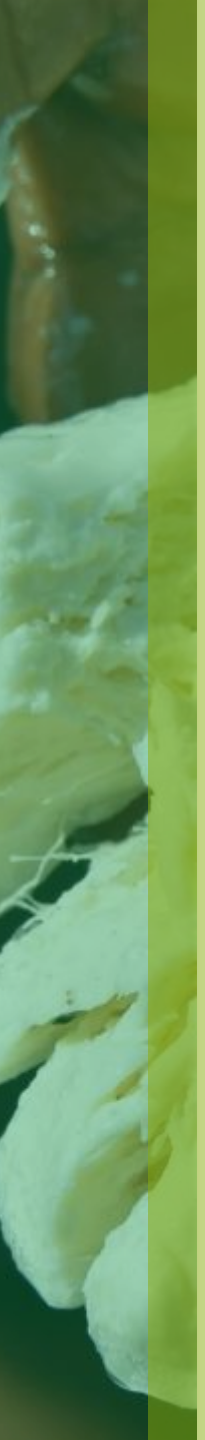
6

f N° of consumers	Column Labels			
bels	1	2	3	Grand Total
106	14%	64%	22%	100%
159	52%	47%	1%	100%
207	31%	54%	15%	100%
322	2%	44%	53%	100%
414	54%	44%	1%	100%
543	27%	57%	16%	100%
Grand Total	**30%**	**52%**	**18%**	**100%**









I. Hedonic test results - *Histogram*

RTB Breeding

Create a histogram to visualize JAR data

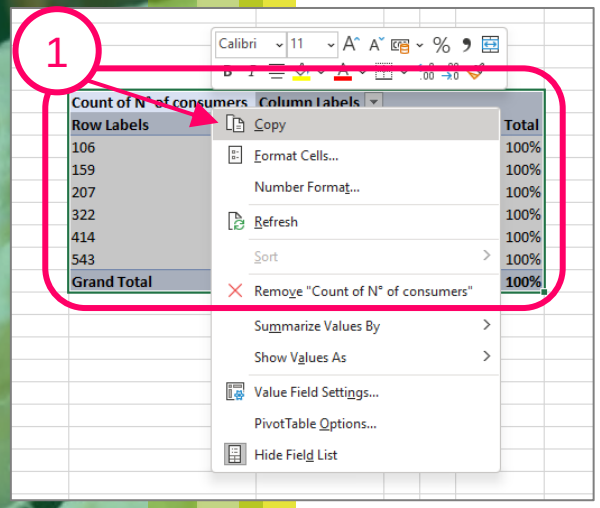
You have different possibilities details in this guide :

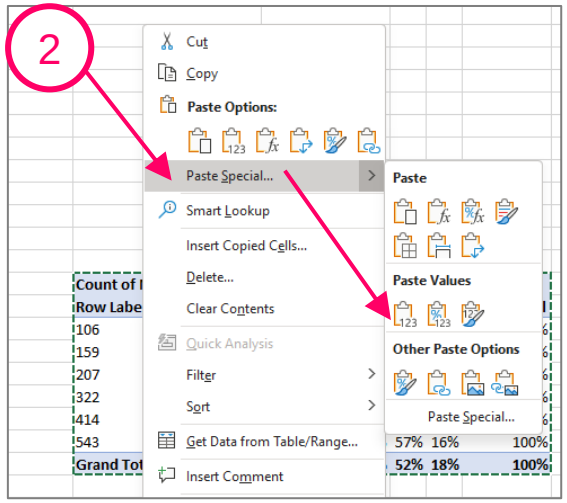
Geneviève FLIEDEL, Isabelle MARAVAL, Aurélie BECHOFF, Eglantine FAUVELLE, (2022). *Guidance for Consumer Testing Data Analysis & Reporting - Supplement to Step 4. Understanding the Drivers of Trait Preferences and the Development of Multi-user RTB Product Profiles, WP1, Step 4.* Montpellier, France: RTBfoods Methodological Report, 50 p. https://doi.org/10.18167/agritrop/00660

→ In this tutorial, only one is presented !

I. Hedonic test results - *Histogram*

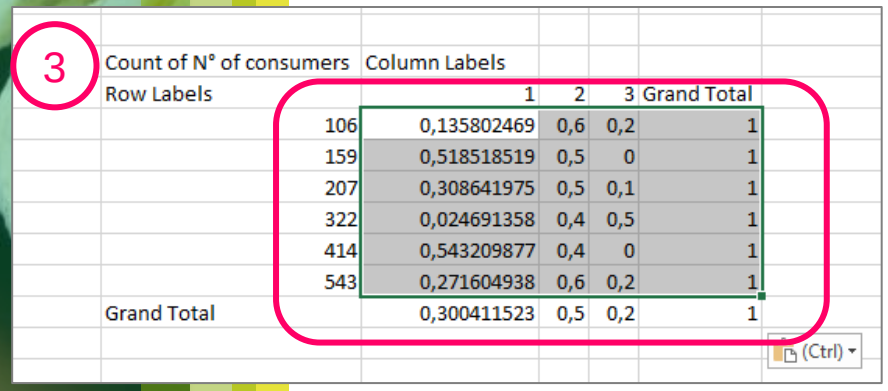
RTB Breeding

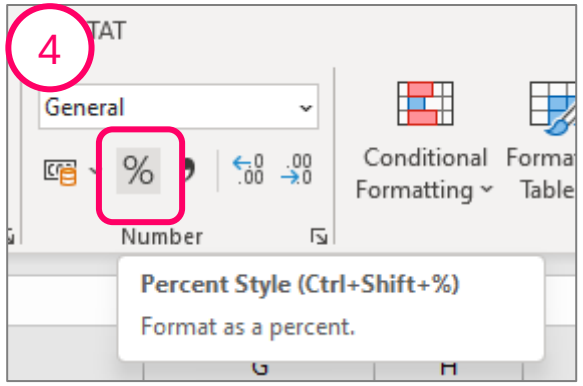


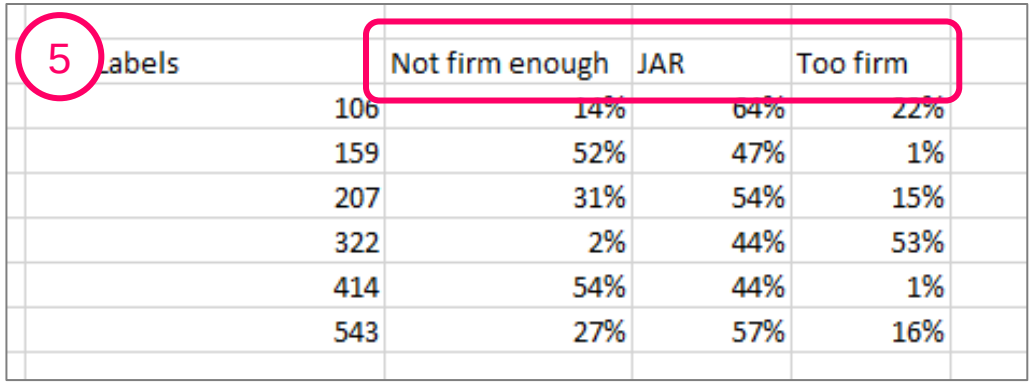


1. Select pivot table > right-click > **Copy**
2. Beside to you Pivot Table > right-click > **Paste special** > **Values**
3. Select the decimal values in your table
4. Click on **Percentage Style**
5. Delete the “Grand Total” row and column.

Rename the columns label “1, 2, 3” by : **Not firm enough, JAR and Too firm**





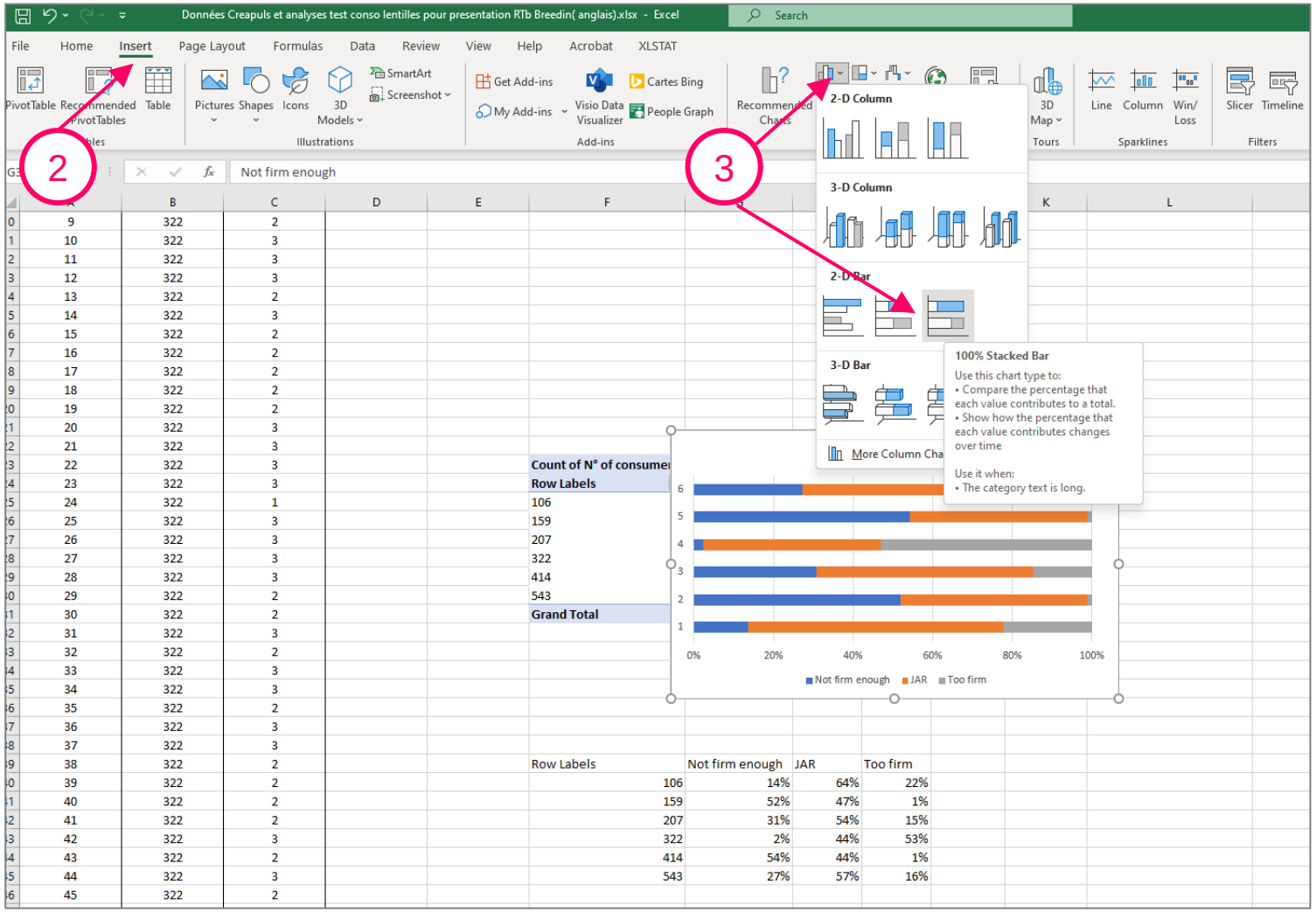


I. Hedonic test results - *Histogram*

RTB Breeding

1. Select the data in your table.
2. Select **Insert** > **Chart**
3. Select **Histogram 2D bar**

Row Labels	Not firm enough	JAR	Too firm
106	14%	64%	22%
159	52%	47%	1%
207	31%	54%	15%
322	2%	44%	53%
414	54%	44%	1%
543	27%	57%	16%

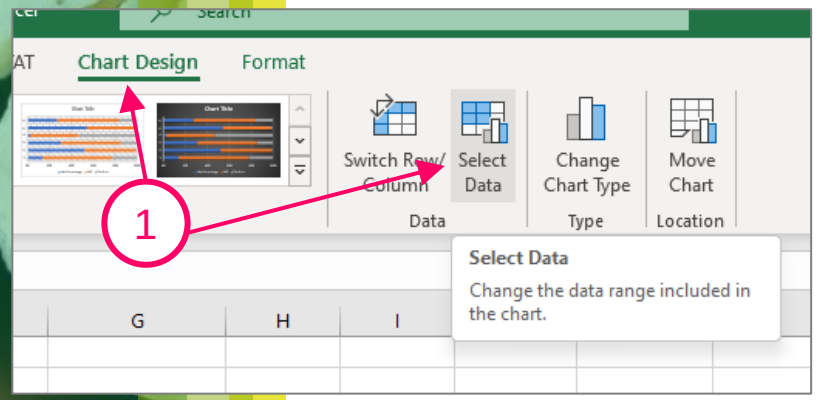


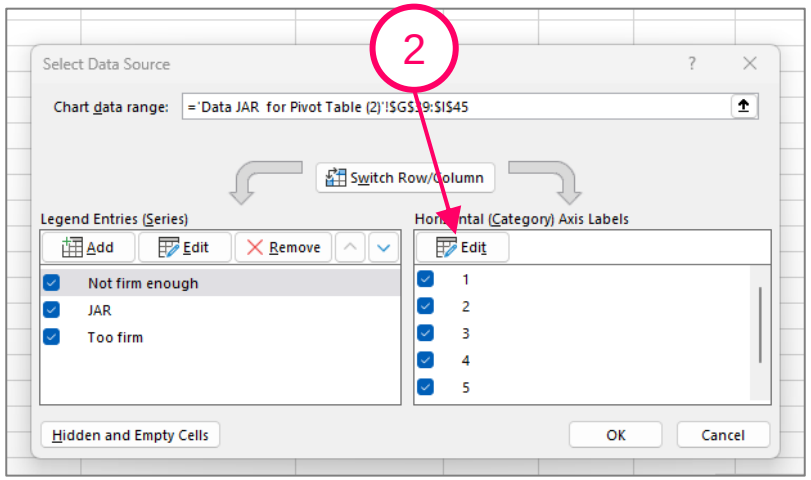
I. Hedonic test results - *Histogram*

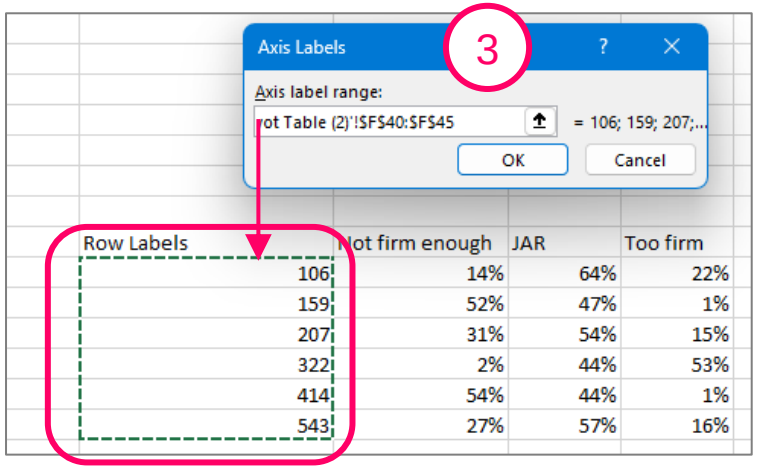
RTB Breeding

Add sample code to histogram:

1. Click on **Chart Design** > **Select Data**
2. The Select Data Source window opens > In the right-hand section **Horizontal (Category) Axis Label >** click on **Edit**
3. In the **Axis Labels** window that opens > select your samples codes in your table. Click on **OK**





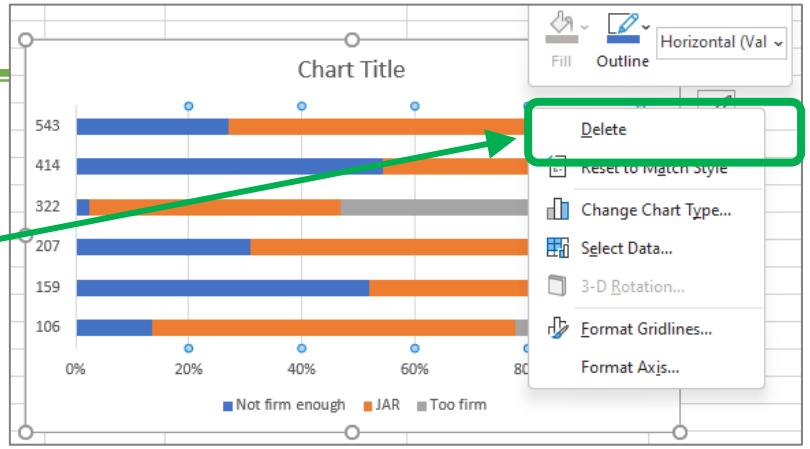


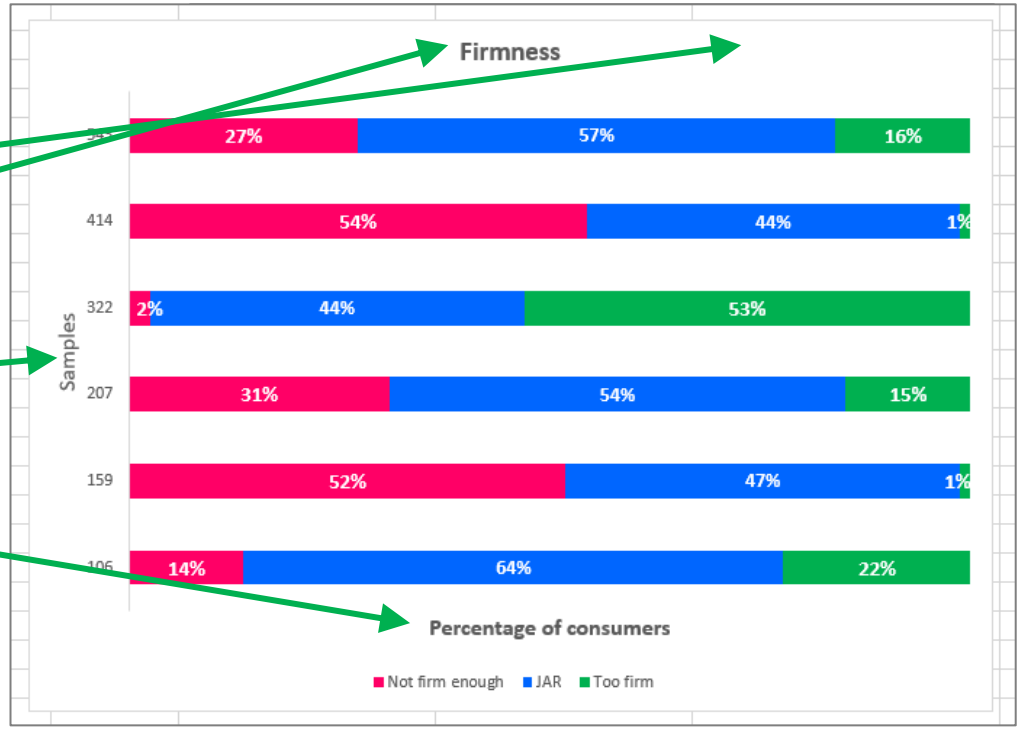
I. Hedonic test results

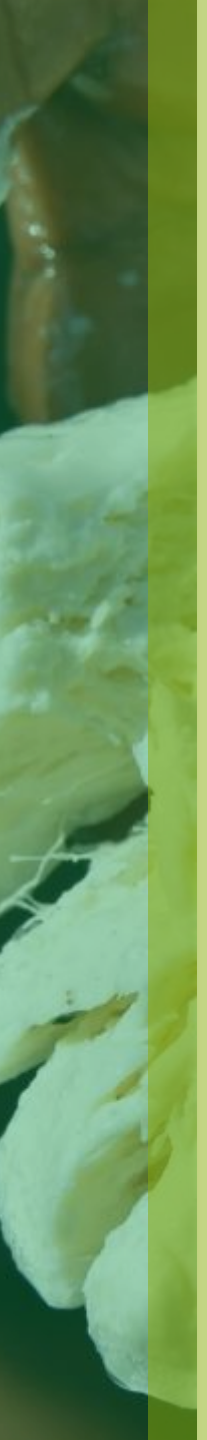
RTB Breeding

Other changes you can make to your histogram :

- Delete the **grids** by left-clicking on it > right-clicking and pressing the “**Delete**” button
- Right Click on the **x-axis scale** in the Chart > press the “**delete**” button
- Click on the graph, click on the **+** on the right, and check **Axis Title** and **Data Labels**
- You can choose a **Title** for the chart and for **x-axis** and for **y-axis**
- You can modify the **colour** of each bar by right clicking on the bar and change the colour







II. Descriptive test results - *QDA*

RTB Breeding

- Descriptive Test of Sensory Evaluation :
  QDA = Quantitative Descriptive Analysis
- Objectif : establish a sensory profile of the food product
- How ? Quantifying the intensity of descriptors perceived in the product (list drawn up before analysis) by a panel of trained judges
- More details → **Module n°4**

Sample n° :

In the order of descriptors, circle the number corresponding to the intensity of the descriptor you perceive in the sample.

Firmness:

0 1 2 3 4 5 6 7 8 9 10

Humidity

0 1 2 3 4 5 6 7 8 9 10

Sweetness

0 1 2 3 4 5 6 7 8 9 10

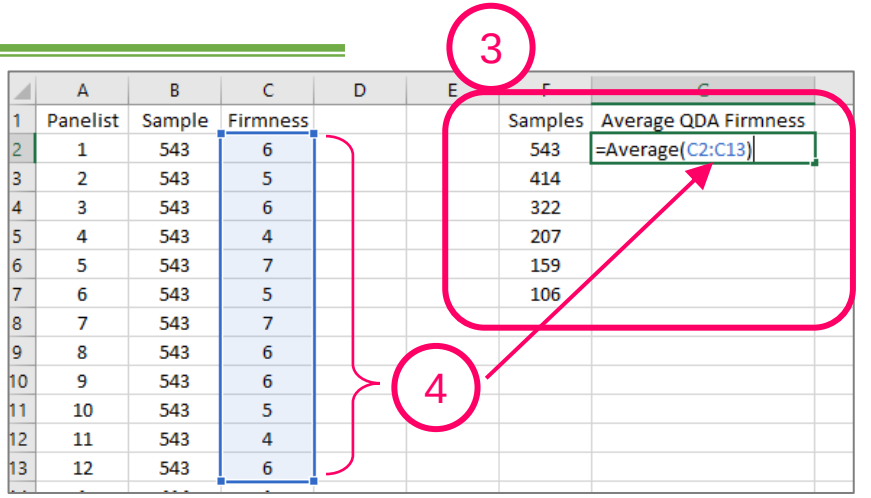
II. Descriptive test results - *QDA*

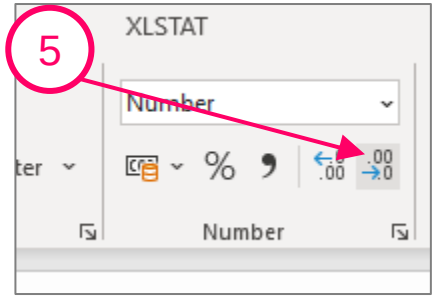
RTB Breeding

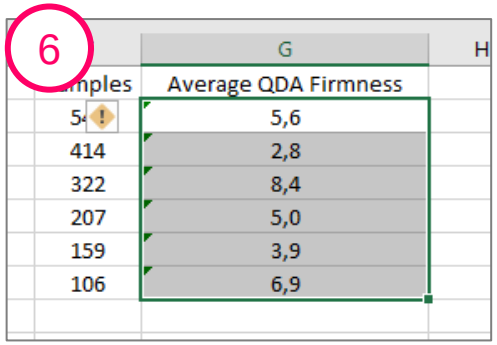
	A	B	C
1	Panelist	Sample	Firmness
2	1	543	6
3	2	543	5
4	3	543	6
5	4	543	4
6	5	543	7
7	6	543	5
8	7	543	7
9	8	543	6
10	9	543	6
11	10	543	5
12	11	543	4
13	12	543	6
14	1	414	1
15	2	414	3
16	3	414	4
17	4	414	2
18	5	414	4
19	6	414	3
20	7	414	2
21	8	414	3
22	9	414	4
23	10	414	3
24	11	414	3
25	12	414	2
26	1	322	9
27	2	322	9
28	3	322	8
29	4	322	8
30	5	322	10
31	6	322	6
32	7	322	7
33	8	322	7
34	9	322	8
35	10	322	9
36	11	322	9
37	12	322	7

1. Enter raw data into a Excel table :
   - First column = your panelist number
   - Second column = samples
   - Following columns = sensory descriptors
2. Sort results by sample
3. Create a second table next to the first :
   - 1st column : sample numbers
   - 2nd column: average firmness calculated for each sample over the entire panel
4. To calculate the average : type **=AVERAGE** in the empty cell and **select the cells in your first table** (firmness column) whose Average you want to calculate.

   Repeat this calculation for each sample.
5. On the resulting table, reduce the number of decimal places: **select the row with averages** and click on **Decrease decimal**
6. Final table to use for calculating thresholds





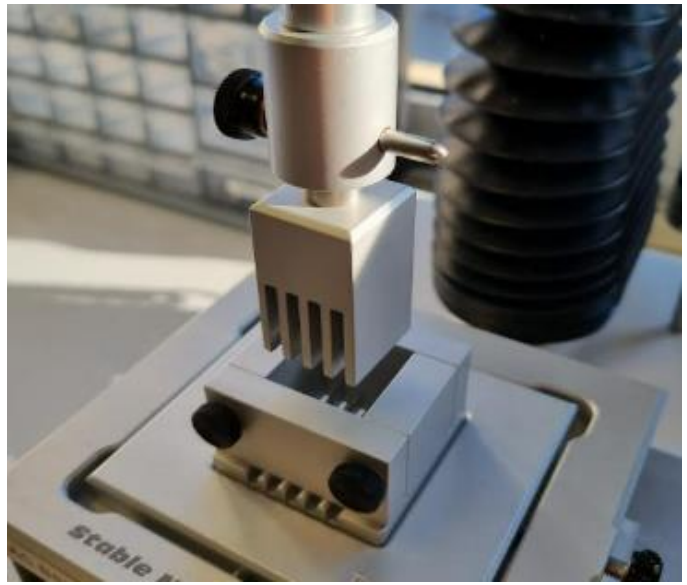


II. Descriptive test results - *Instrumental measures*

If you have a reliable instrumental method whose correlation with sensory data you have demonstrated: you can use the instrumental data to calculate thresholds.

Example of firmness measurement using the Kramer cell :

1. Enter raw data into a Excel table :
   - First column = samples
   - Second column = instrumental mesures



1

	A	B
	Samples	Fmax_exp (N/g b.h)
2	322	16,84
3	106	13,89
4	543	11,64
5	207	10,08
6	159	7,15
7	414	5,51
8		

III. Calculation of acceptability thresholds

RTB Breeding

A) Using JAR test results and QDA results (use data from the JAR and Average QDA columns)

1. **Gather the JAR test and QDA results in the same table**: select the table with the JAR results you used to draw the histograms > right-click > **Copy** > Select an empty cell next to the table with the QDA averages > right-click > **Paste options** > **Values(V)**

2. Caution: check that the rows in the two adjacent tables correspond to the same samples. If this is not the case, **put the rows of one table in the same order as the other**

3. **Remove the "Labels JAR test"** column and keep only one column with sample names

1

	A	B	C	D	E	F
1	Samples	Average QDA Firmness	Labels JAR test	lot firm enoug	JAR	Too firm
2	543	5,6	106	14%	64%	22%
3	414	2,8	159	52%	47%	1%
4	322	8,4	207	31%	54%	15%
5	207	5,0	322	2%	44%	53%
6	159	3,9	414	54%	44%	1%
7	106	6,9	543	27%	57%	16%
8						

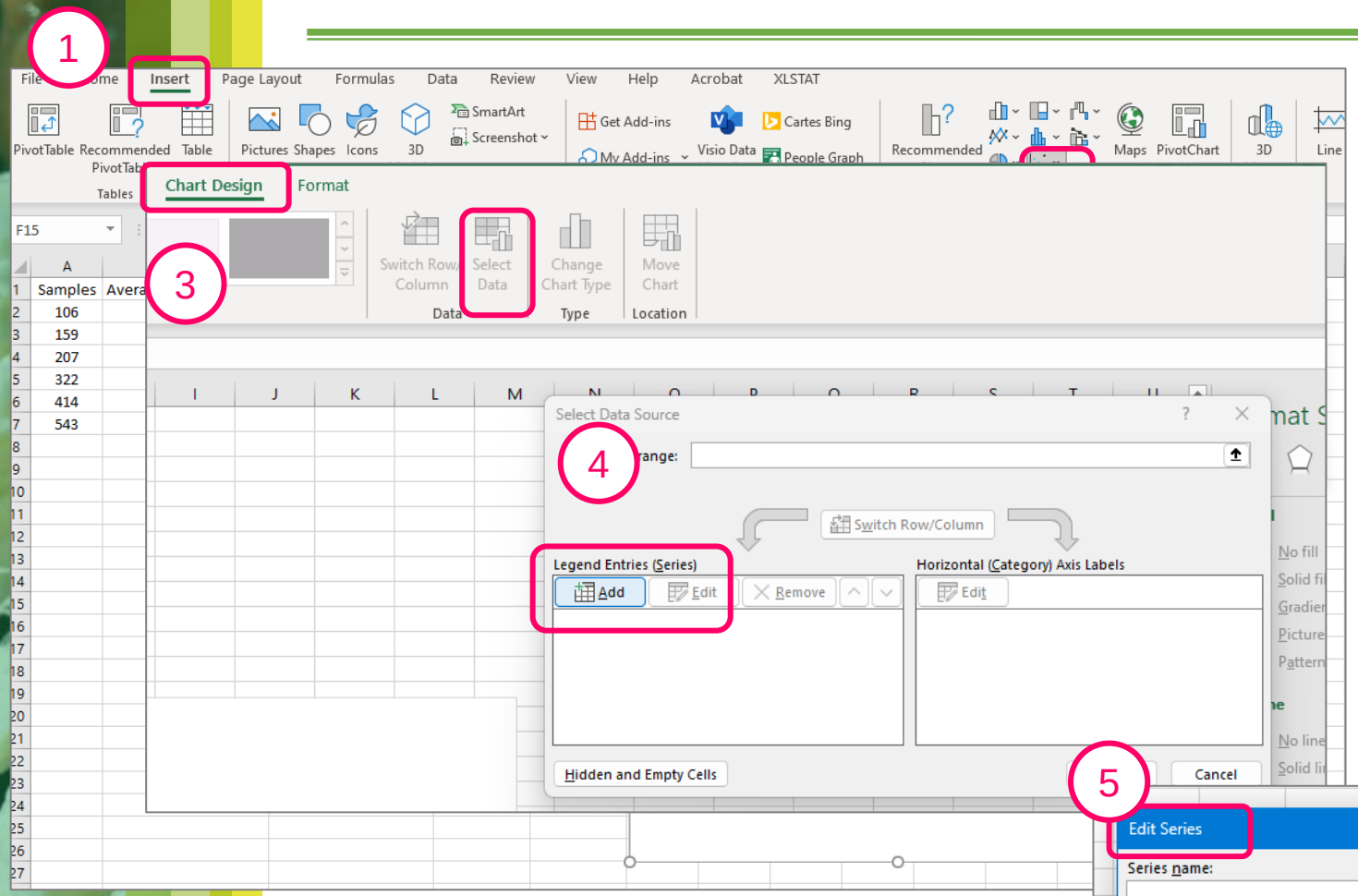
2

3

	A	B	C	D	E
1	Samples	Average QDA Firmness	Not firm enough	JAR	Too firm
2	106	6,9	14%	64%	22%
3	159	3,9	52%	47%	1%
4	207	5,0	31%	54%	15%
5	322	8,4	2%	44%	53%
6	414	2,8	54%	44%	1%
7	543	5,6	27%	57%	16%
8					

III. Calculation of acceptability thresholds

RTB Breeding



Draw both types of graph to define thresholds:

1. **Insert** > **Insert Scatter or Bubble Chart** > **Scatter**
2. **Click** on the **white square**
3. Click on **Chart Design** > **Select Data**
4. In the **Legend Entries (Series)** window, click on **Add**
5. In the windows **Edit Series** > **Series X values**> select values for the **Average QDA Firmness** column
6. **Edit Series** > **Series Y values** > select values of **JAR column** > OK

	A	B	C	D	E
	Samples	Average QDA Firmness	Not firm enough	JAR	Too firm
2	106	6,9	14%	64%	22%
3	159	3,9	52%	47%	1%
4	207	5,0	31%	54%	15%
5	322	8,4	2%	44%	53%
6	414	2,8	54%	44%	1%
7	543	5,6	27%	57%	16%

6

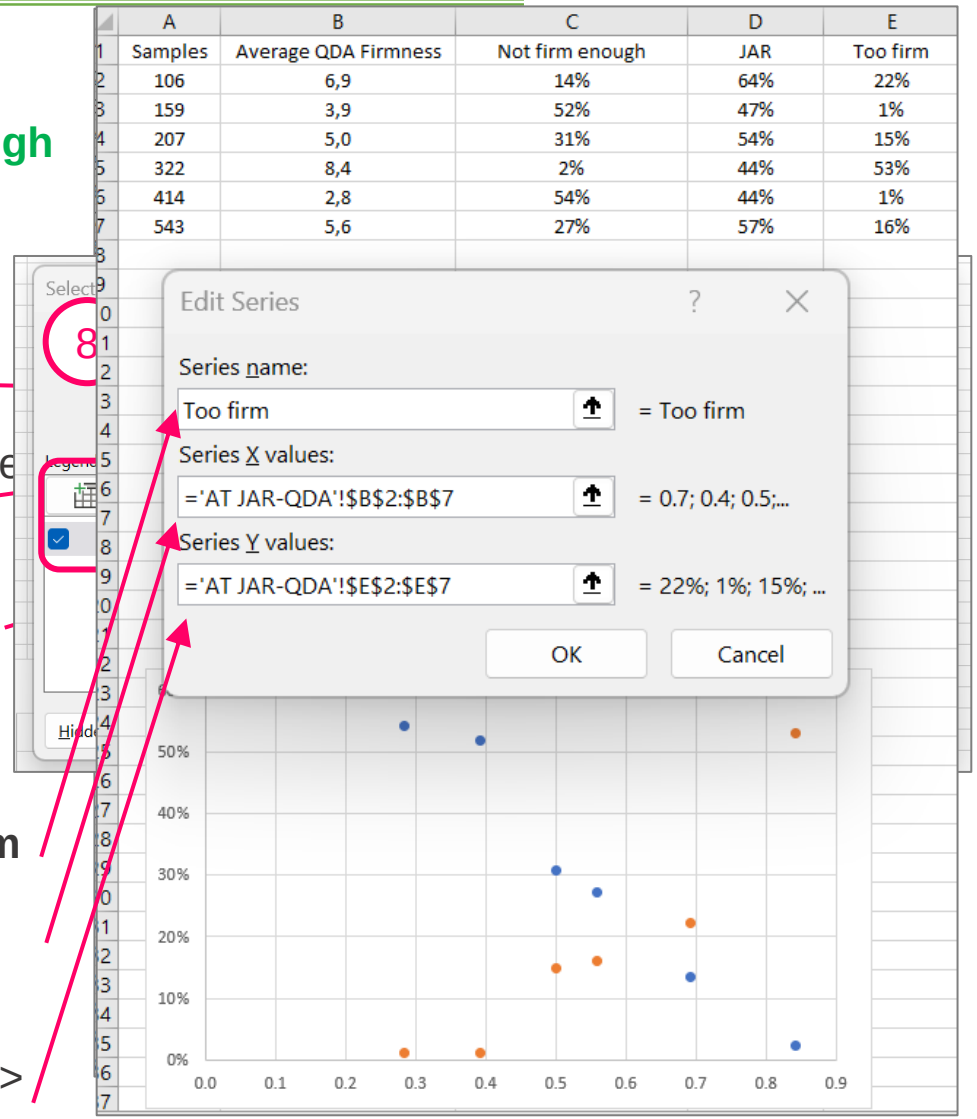
III. Calculation of acceptability thresholds

RTB Breeding

A) Using JAR test results and QDA results → unlike the previous version, here we will use data from the **Not firm enough** and **Too firm** columns

Steps 1 to 4 are the same as on the previous slide

5. Series Name > write **Not Firm Enough**
6. In the windows **Edit Series** > **Series X values**> select value for the **Average QDA Firmness** column
7. **Edit Series** > **Series Y values** > select values of **Not firm enough** >**OK**
8. Click again on Add
9. In the windows **Edit Series >Series Name** > write **Too Firm**
10. **Series X values** > select values for the **Average QDA Firmness** column (same as n°5)
11. **Edit Series** > **Series Y values** > select values of **Too firm** > OK

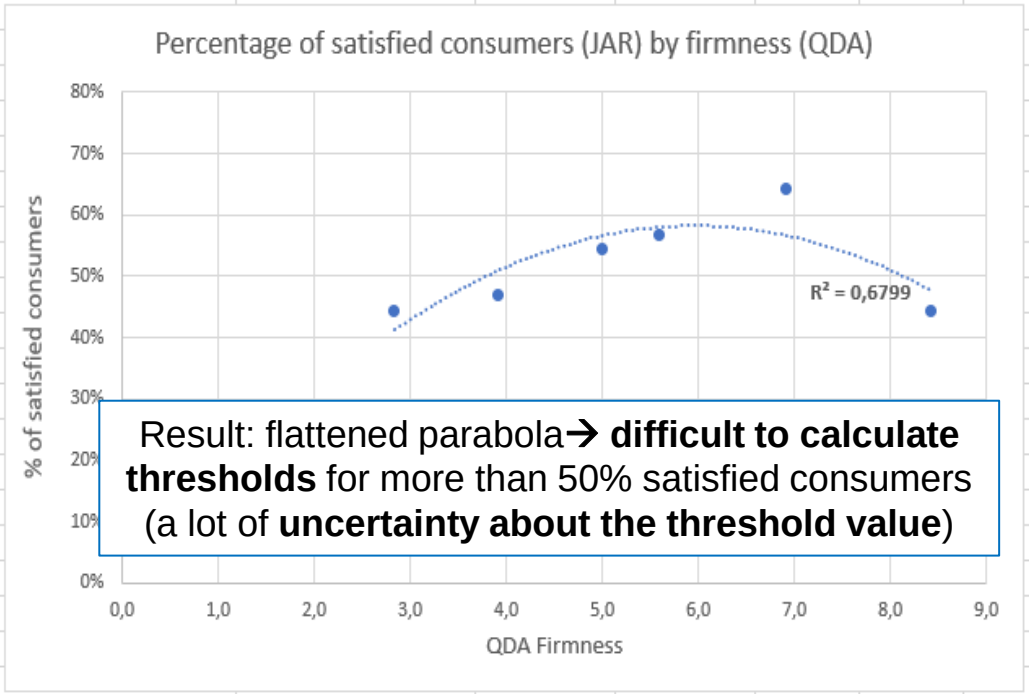


III. Calculation of acceptability thresholds

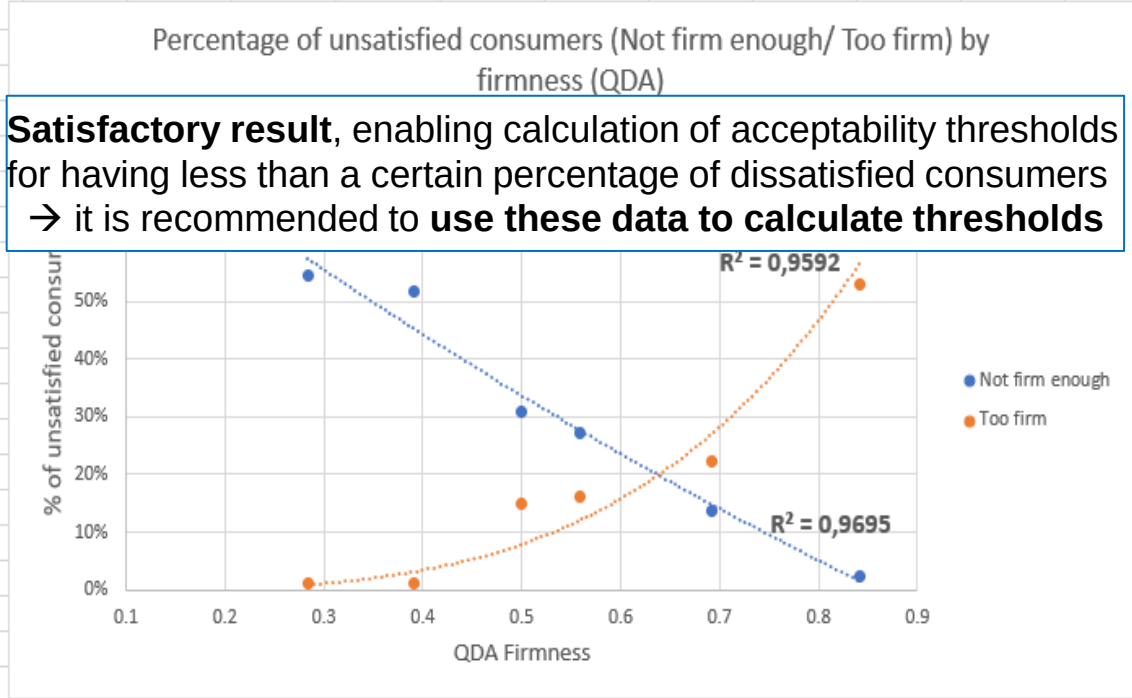
RTB Breeding

A) Using JAR test results and QDA results : Two graphs: one obtained from the **average QDA and JAR columns (% satisfied consumers,** on the left) and the other from the **average QDA,** the **Not firm enough** and **Too firm columns (% dissatisfied consumers**, on the right).

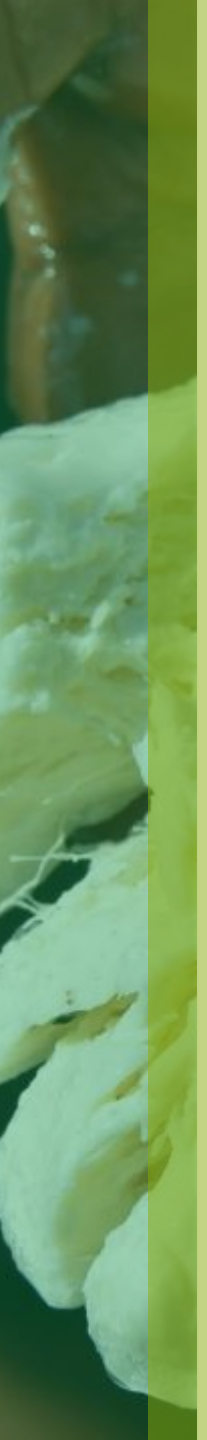
The two graphs after modifications/additions



Result: flattened parabola→ **difficult to calculate thresholds** for more than 50% satisfied consumers (a lot of **uncertainty about the threshold value**)



Satisfactory result, enabling calculation of acceptability thresholds for having less than a certain percentage of dissatisfied consumers → it is recommended to **use these data to calculate thresholds**



III. Calculation of acceptability thresholds

RTB Breeding

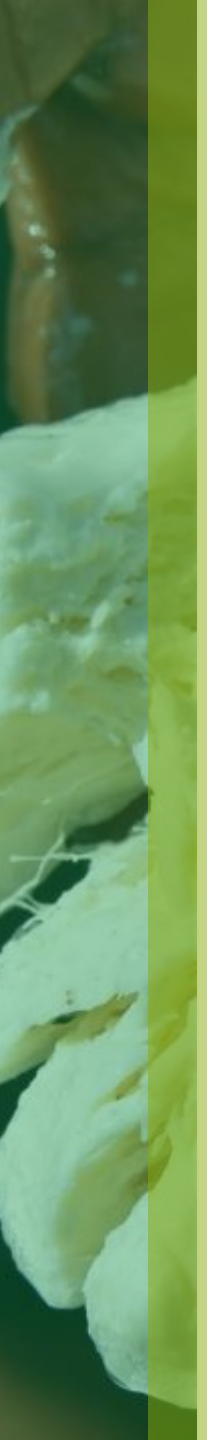
B) Using JAR test results and instrumental results

The **procedure for obtaining graphs from instrumental and JAR** data is exactly **the same as** when using **QDA and JAR data**. Simply replace the column Average QDA with Instrumental measure

→ **Gather the JAR test and Instrumental results in the same table**: select the table with the JAR results you used to draw the histograms > right-click > **Copy** > Select an empty cell next to the table with the Instrumental measures > right-click > **Paste options** > **Values(V)**

Caution: check that the rows in the two adjacent tables correspond to the same samples. If this is not the case, **put the rows of one table in the same order as the other**

	A	B	C	D	E
1	Samples	Fmax_exp (N/g b.h)	Not firm enough	JAR	Too firm
2	106	13,89	14%	64%	22%
3	159	7,15	52%	47%	1%
4	207	10,08	31%	54%	15%
5	322	16,84	2%	44%	53%
6	414	5,51	54%	44%	1%
7	543	11,64	27%	57%	16%
8					

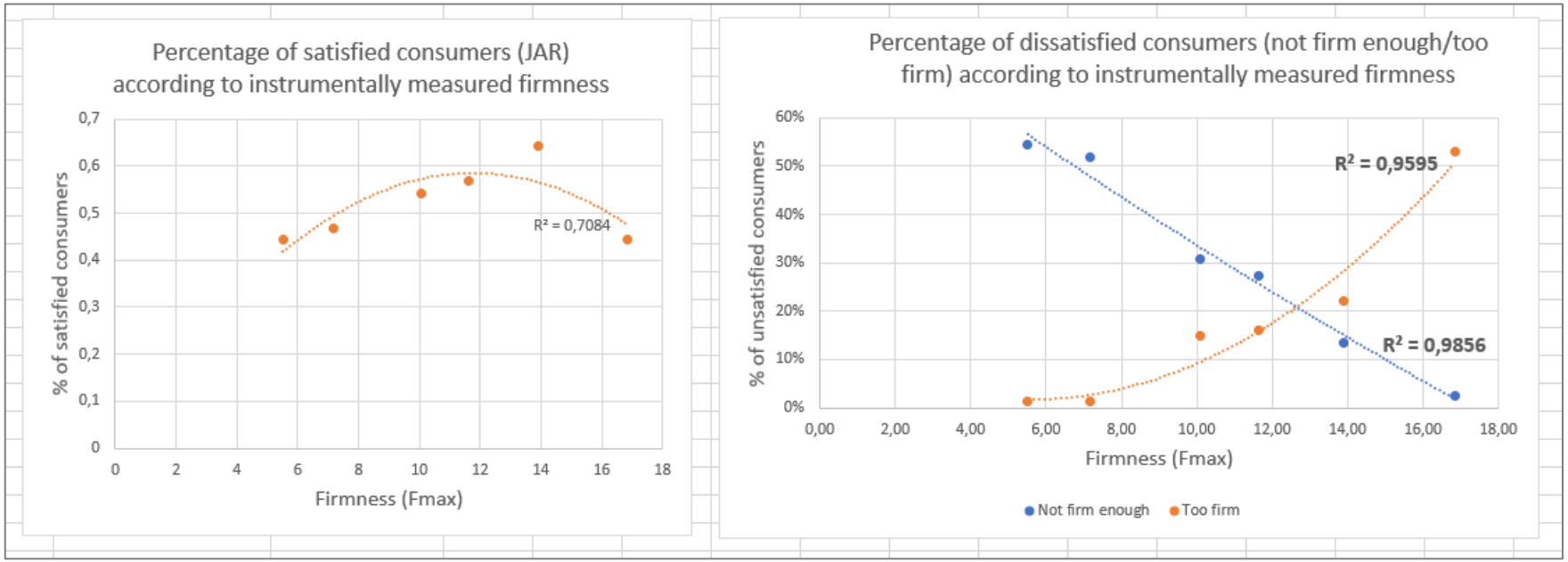


III. Calculation of acceptability thresholds

RTB Breeding

B) Using JAR test results and instrumental results

The procedure for obtaining graphs from instrumental and JAR data is exactly the same as when using QDA and JAR data. Simply replace the column Average QDA with Instrumental measures

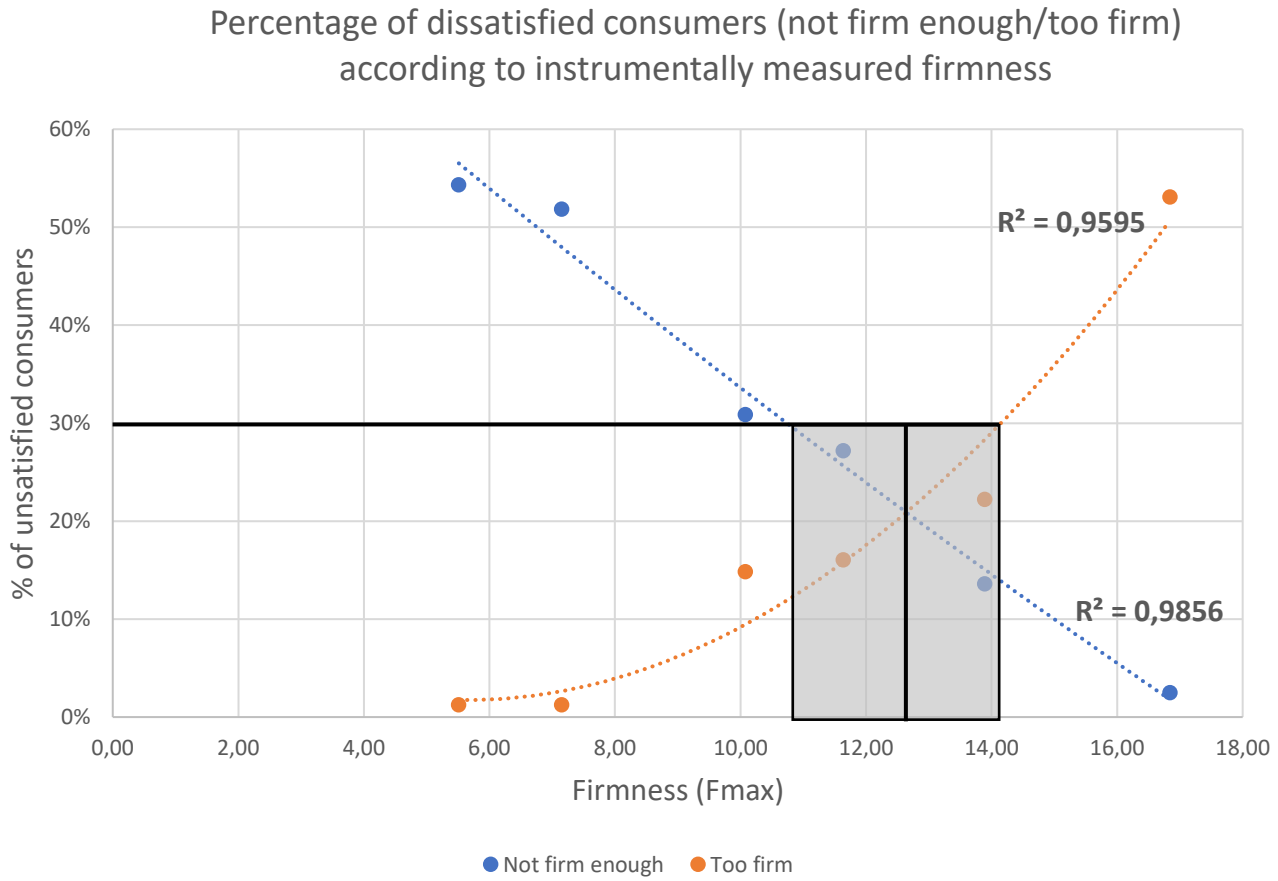


On these graphs : more satisfactory results using data from dissatisfied consumers (on the right) than those who are satisfied → use the graph on the right to calculate acceptability thresholds

III. Calculation of acceptability thresholds

RTB Breeding

B) Using JAR test results and instrumental results



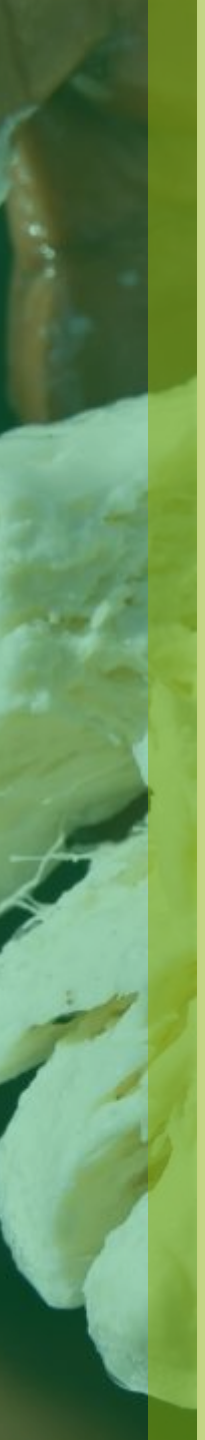
As measured firmness increases :

→ the % of consumers who find the product not firm enough decreases

→ the % of consumers finding producut too firm increases

Acceptability threshold for firmness defined so that **less than 30% of consumers are dissatisfied** (It's up to you to choose the thresholds you wish to apply) :

10,8 N/g < Acceptable firmness (optimal :13,5) < 14 N/g



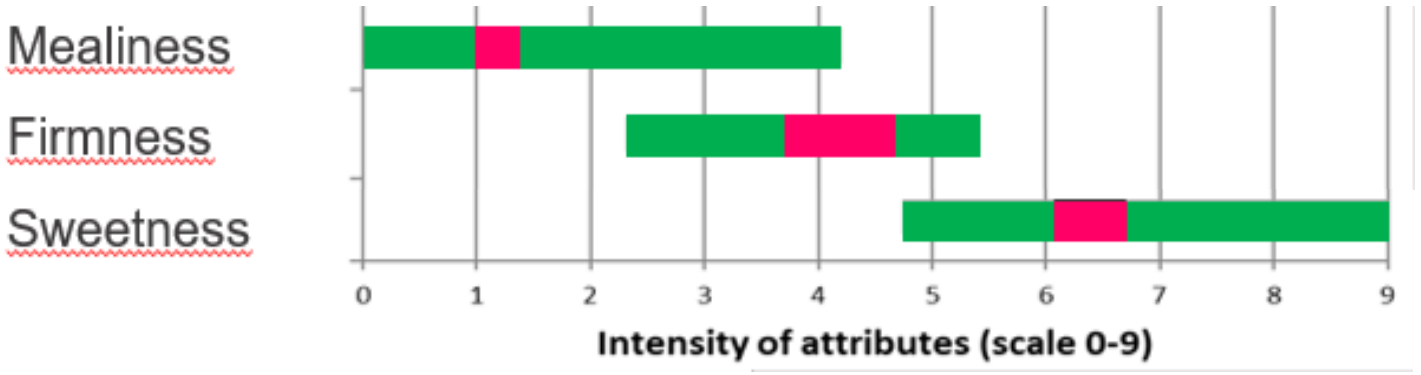
What's the point of calculating these thresholds of acceptability?

→ Integrating consumer preferences into selection programs

Module n°6 : Hybrid selection: example of dessert banana

Hybrid Selection

So far, we've developed an acceptability threshold (AT) calculation for a single descriptor, firmness. But it is possible to do so for other descriptors, as shown in this example of dessert bananas for mealiness or sweetness.



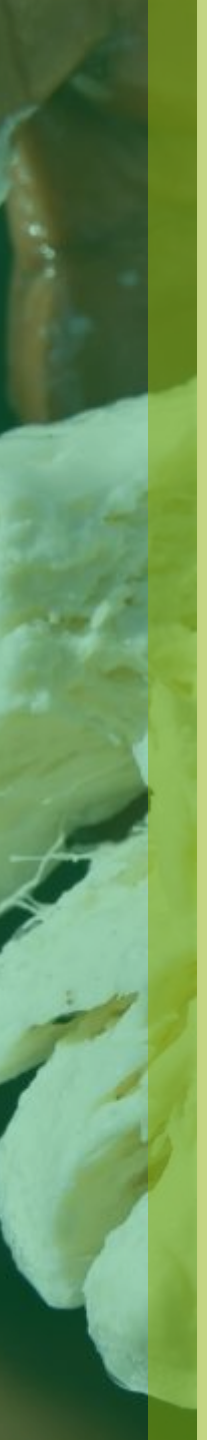
→ AT Mealiness: 0 – 4,2

→ AT Firmness: 2,3 – 5,4

→ AT Sweetness: 4,7 – 9

→ For each sensory attribute, sensory thresholds were assessed :

- **Optimal thresholds** (red): For **less than 20% of unsatisfied consumers**
- **Acceptability thresholds** (green): For **less than 33% of unsatisfied consumers**



Hybrid Selection

RTB Breeding

How screen the hybrids according acceptability thresholds?

→Select hybrids whose measured values for the various descriptors fall within the range of acceptability thresholds.

Example for dessert banana firmness: We determine that **: 2,3 < acceptable firmness < 5,4**

Interpretation: If the firmness value of the hybrid n°1 is between 2,3 and 5,4, the hybrid n°1 has acceptable firmness for consumers

- → this process is carried out for all hybrids and descriptors whose acceptability thresholds have been calculated
- → How to do it concretely? → explanations in the following slides

Hybrid Selection

RTB Breeding

1. In Practice: Fill in an **Excel table** with the **various hybri**
   - Columns : different hybrids
   - Rows: sensory or instrumental values of the vari

2. Below this table, you'll create **a second table**, with the
   you'll complete it based on **a condition** : if the cell in th
   and 5.4 for the firmness), the value in the second will b
   value will be 0.

3. The Excel formula to be used to fill in the rows of this table will therefore be of this type (to be adapted according to the thresholds): =IF(AND(number of the cell you want to check is within the threshold>low threshold value; number of the cell you want to check is within the threshold< high threshold value);1;0).

   In practice in the case of firmness **type** > =IF(AND(B2>2,3;B2<5,4);1;0) > Press **Enter**

3

=IF(AND(B2>2,3;B2<5,4);1;0)

	A	B	C	D	E
1	**Hybrids**	**1**	**2**	**3**	**4**
2	**Firmness**	5,8	5	8	4,1
3	**Mealiness**	7,7	7,8	8,6	1,1
4	**Sweetness**	8,3	5,2	8,4	6,3
5					
6					
7	**Hybrids**	**1**	**2**	**3**	**4**
8	**Firmness**	=IF(AND(B2>2,3;B2<5,4);1;0)			
9	**Mealiness**	0			
10	**Sweetness**	1			

1

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
1	**Hybrids**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
2	**Firmness**	5,8	5	8	4,1	0,1	5,6	6,5	5,5	2,7	4,4	6	4,6	9	1,1	0,6	3,2	7,8	4,4	7,3	6,3
3	**Mealiness**	7,7	7,8	8,6	1,1	6,6	9,5	8,8	2,6	9,6	2,2	3	2,1	4,4	2,5	0,9	3,7	4,1	6,1	8,1	4
4	**Sweetness**	8,3	5,2	8,4	6,3	2,1	3,5	9,4	8,9	6,3	2,5	4,7	8,2	4,1	3,1	5	6,5	3,2	4,3	6,5	7,2

2

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
	Hybrids	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
8	**Firmness**	=IF(AND(B2>2,3;B2<5,4);1;0)																			
9	**Mealiness**	0																			
10	**Sweetness**	1																			

Hybrid Selection

RTB Breeding

1. **Select the cell** in which you have typed the formula > **drag to the right** to apply the formula to the entire line corresponding to the firmness. **Carry out the same steps for all the descriptors** in your table (adapting cell numbers and threshold values)
2. **Add a row** that you can call **Total**
3. Use the **Sum formula** (=Sum(all column cells)) to sum the values in each column
4. **Draw the formula** in all the **Total row** to get the sum of all the columns

3

	A	B
	brids	**1**
2	**Firmness**	5,8
3	**Mealiness**	7,7
4	**Sweetness**	8,3
5		
6		
7	**Hybrids**	**1**
8	**Firmness**	0
9	**Mealiness**	0
10	**Sweetness**	1
11	Total =	=SUM(B8:B10)
12		

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
	Hybrids	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
	Firmness	5,8	5	8	4,1	3	5,6	6,5	5,5	2,7	4,4	6	4,6	9	1,1	0,6	3,2	7,8	4,4	7,3	3,1
	Mealiness	7,7	4	8,6	1,1	6,6	9,5	8,8	2,6	9,6	2,2	3	2,1	4,4	2,5	0,9	3,7	4,1	3	8,1	4
	Sweetness	8,3	5,2	8,4	6,3	2,1	3,5	9,4	8,9	6,3	2,5	4,7	8,2	4,1	3,1	5	6,5	3,2	4,3	6,5	7,2
	Hybrids	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
	Firmness	0	1	0	1	1	0	0	0	1	1	0	1	0	0	0	1	0	1	0	1
	Mealiness	0	1	0	1	0	0	0	1	0	1	1	1	0	1	1	1	1	1	0	1
	Sweetness	1	1	1	1	0	0	0	1	1	0	0	1	0	0	1	1	0	0	1	1
	Total =	**1**	**3**	**1**	**3**	**1**	**0**	**0**	**2**	**2**	**2**	**1**	**3**	**0**	**1**	**2**	**3**	**1**	**2**	**1**	**3**

4

A few examples of interpretations:

H1 is acceptable for sweetness, but not for mealiness and firmness ; H2 is acceptable for the 3 attributes, H5 is acceptable for firmness, but not for mealiness and sweetness; H6 is not acceptable for any attributes; H14 is acceptable for mealiness but not for firmness and sweetness …

Hybrid Selection

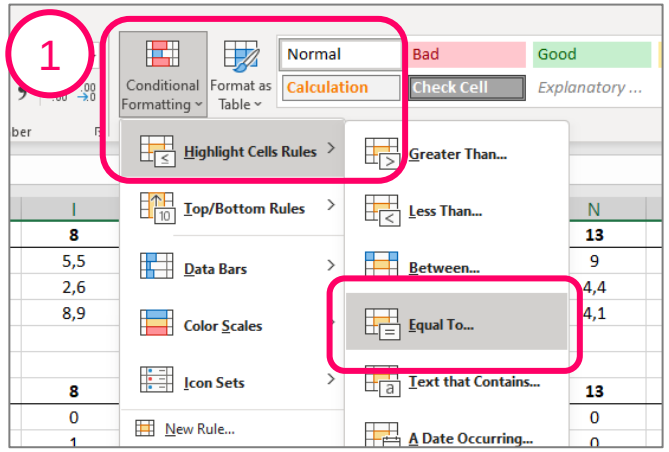
RTB Breeding

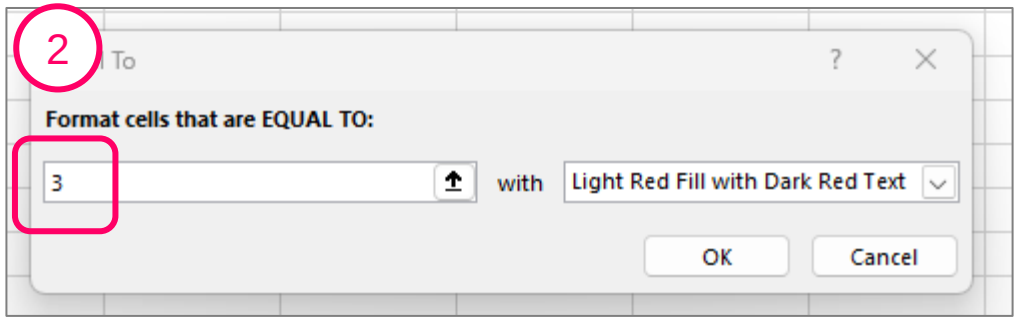
In the total row : if **the sum of the column is 3**, this means that **all sensory attributes have values within the threshold of acceptability** in the hybrids.

1. To quickly see cells where the number equals 3, add a highlighting rule:

Select the **Total row** > click on **Conditional Formatting** > **Highlight Cells Rules** > **Equal To**

2. Enter **3** > **OK**





3. Values equal to three are highlighted in red and easily visible

3

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
ss	0	1	0	1	1	0	0	0	1	1	0	1	0	0	0	1	0	1	0	1
ness	0	1	0	1	0	0	0	1	0	1	1	1	0	1	1	1	1	1	0	1
Sweetness	1	1	1	1	0	0	0	1	1	0	0	1	0	0	1	1	0	0	1	1
Total =	1	3	1	3	1	0	0	2	2	2	1	3	0	1	2	3	1	2	1	3

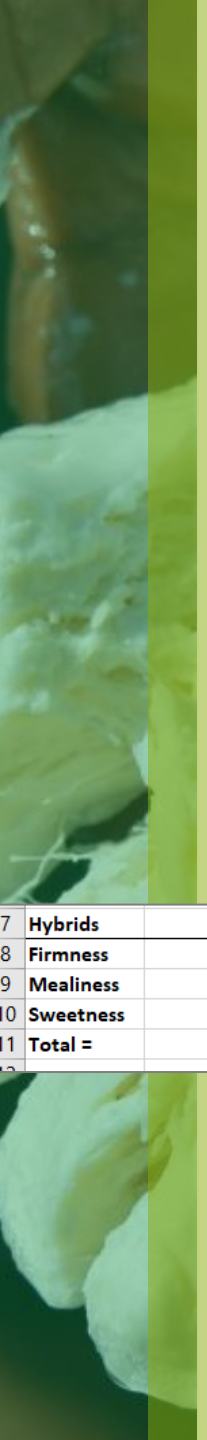
Hybrid Selection

RTB Breeding

To have **less than 33% of consumers dissatisfied** (arbitrary percentage, up to you to determine), the sensory measured firmness of the banana must be between 2.3 and 5.4, the mealiness between 0 and 4.2 and the sweetness between 4.7 and 9. (This corresponds to the different acceptability thresholds measured above).

Hybrids	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Firmness	0	1	0	1	1	0	0	0	1	1	0	1	0	0	0	1	0	1	0	1
Mealiness	0	1	0	1	0	0	0	1	0	1	1	1	0	1	1	1	1	1	0	1
Sweetness	1	1	1	1	0	0	0	1	1	0	0	1	0	0	1	1	0	0	1	1
Total =	**1**	**3**	**1**	**3**	**1**	**0**	**0**	**2**	**2**	**2**	**1**	**3**	**0**	**1**	**2**	**3**	**1**	**2**	**1**	**3**

Of the 20 hybrids presented, if we apply these acceptability thresholds, **only five** (n° 2; n°4; n°12; n°16 and n°20) **have values** for the three sensory attributes **within the threshold range**, and consequently only for these five hybrids will less than 33% of consumers be dissatisfied.



Hybrid Selection

RTB Breeding

On the same principle as with acceptability thresholds, it is possible to select hybrids based on **optimal thresholds**:

To have **less than 20% of dissatisfied consumers** (arbitrary percentage, to be determined), sensory firmness measured for banana should be between 3.8 and 4.8, mealiness between 1 and 1.3 and sweetness between 6.1 and 6.8 (this corresponds to the different optimal thresholds measured previously).

7	Hybrids	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
8	Firmness	0	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0	1	0	0
9	Mealiness	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	Sweetness	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	1	0	0	1	0
11	**Total =**	**0**	**0**	**0**	**3**	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**1**	**0**	**0**	**0**	**1**	**0**	**1**	**1**	**0**

With these new optimum thresholds, **only one of the 20 hybrids** presented corresponds to consumer expectations in our example (n°4).

RTB Breeding

Conclusion : The wider the acceptability thresholds, the more hybrids will meet the acceptability criteria. But, these hybrids are less likely to satisfy a larger proportion of consumers.

Depending on the number of acceptable hybrids, it's up to you to recalculate new acceptability thresholds based on a new % of satisfied or/and unsatisfied consumers.

Thank you !

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Deuscher Zoé, **Adinsi Laurent**, **Bugaud Christophe**. 2025. Activity n°3: Evaluation of acceptability thresholds of key quality traits for the different RTB food products. Online modules n°5 and 6. Montpellier : CIRAD-RTB Breeding Project, 36 p., 1 video (17 min. 25 sec.) https://doi.org/10.18167/agritrop/00850