

HYPERSPECTRAL IMAGE SEGMENTATION AND ANALYSIS TOWARDS AUTOMATED NON-DESTRUCTIVE MEASUREMENTS OF OLIGOSACCHARIDES AND OTHER TRAITS

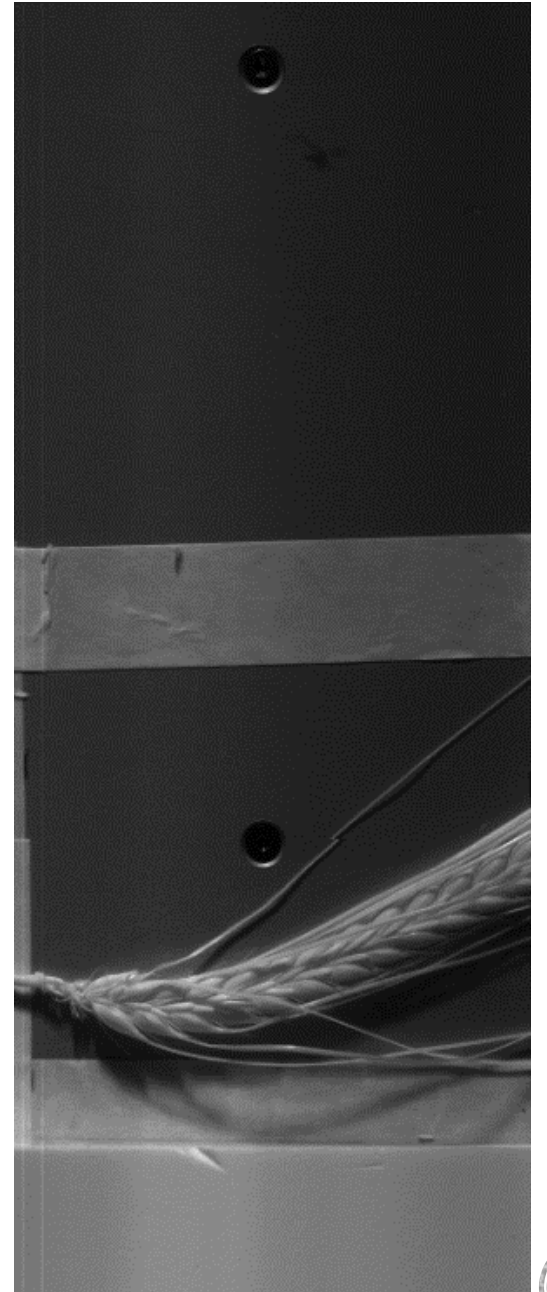
Segmentation



GRAYSCALE REPRESENTATION

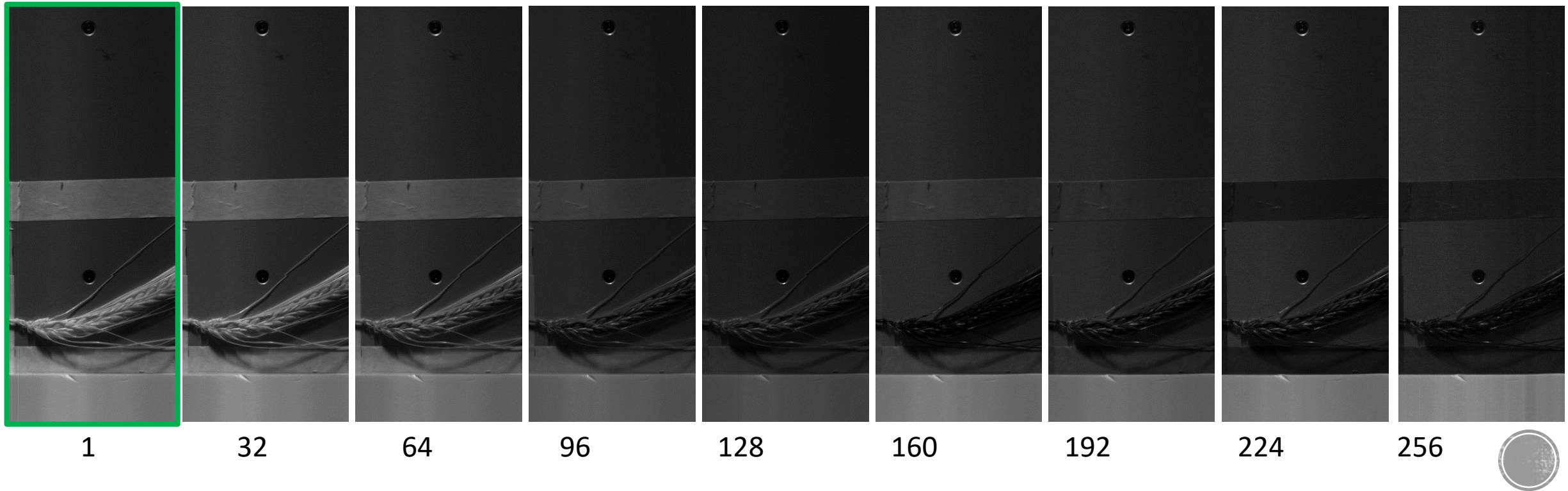
Variable Transformation
For Representation Purpose

$$S' = (S - S_{min}) / (S_{max} - S_{min}) \cdot 256$$

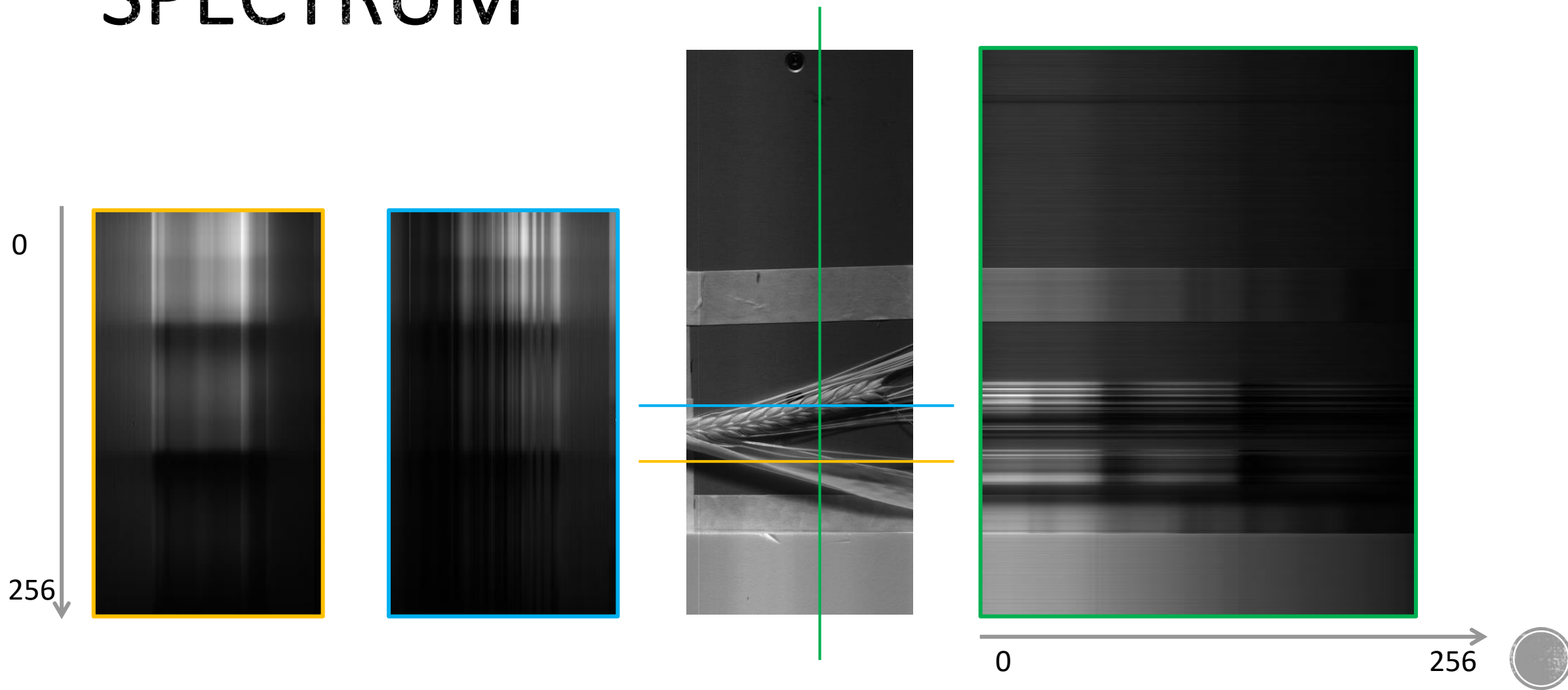


WHICH WAVELENGTHS?

e.g. SWIR with 256 bands

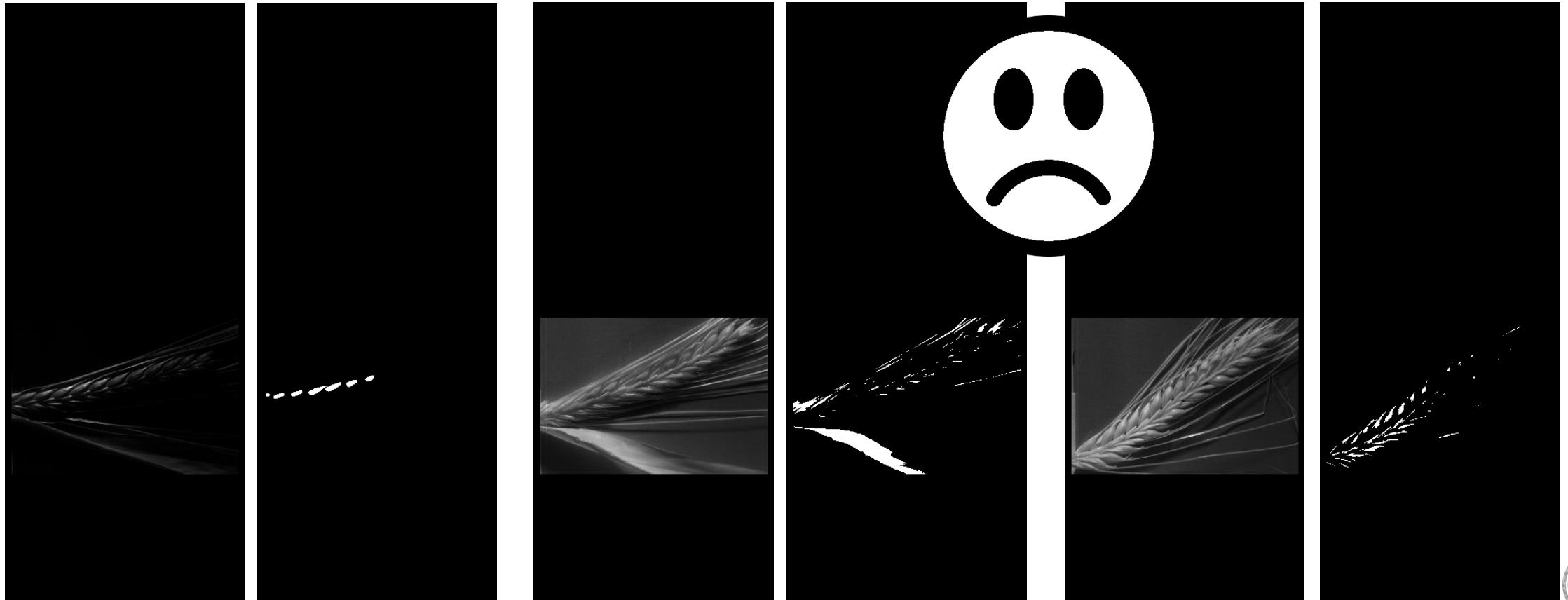


LEAVES SPECTRUM VS GRAINS SPECTRUM



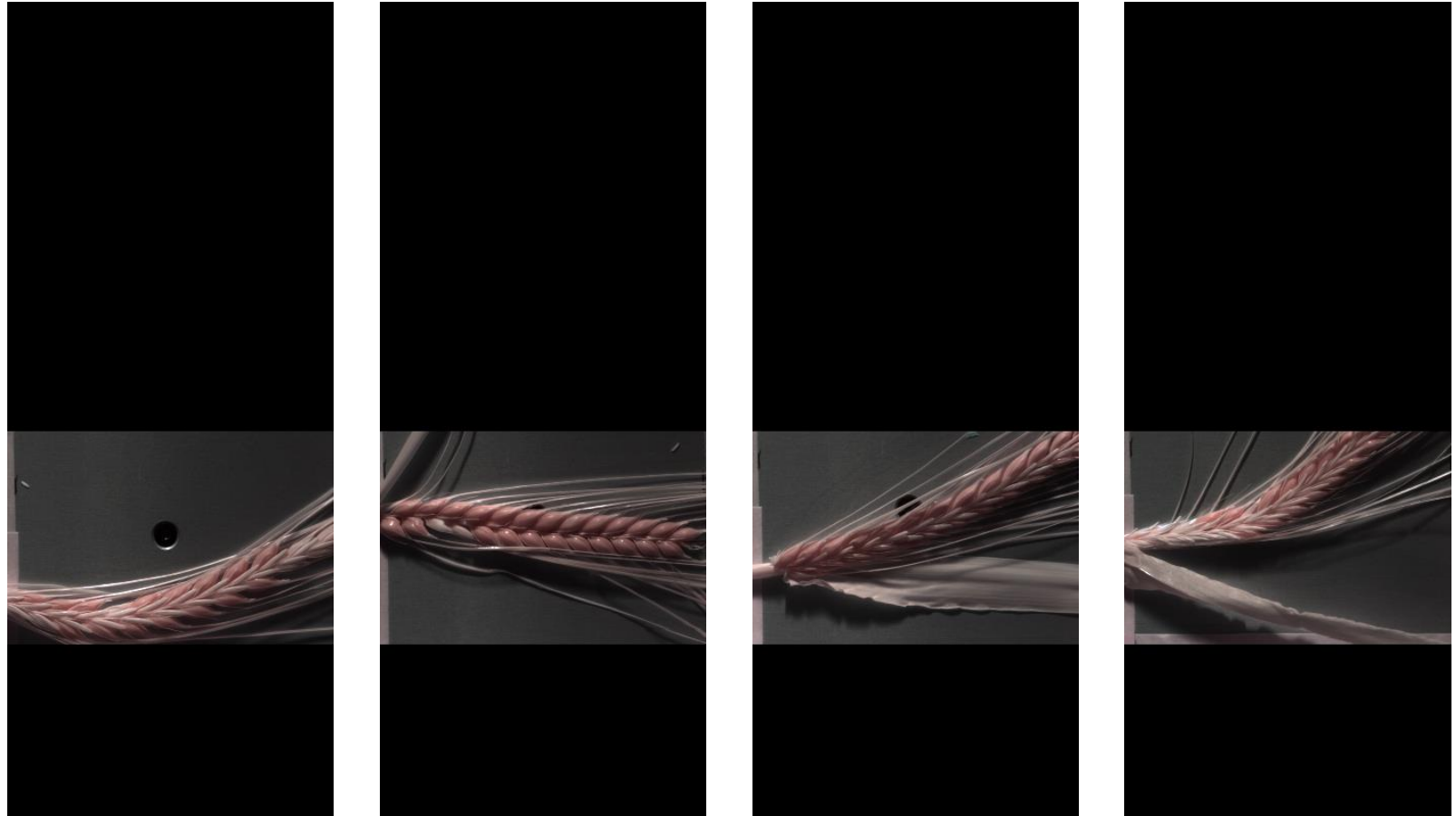
RESULTS BASED ON SINGLE CHANNEL

- Some approaches
 - Global thresholding (difference between first and last channels)
 - Quadratic transformation of values to make threshold value selection easier



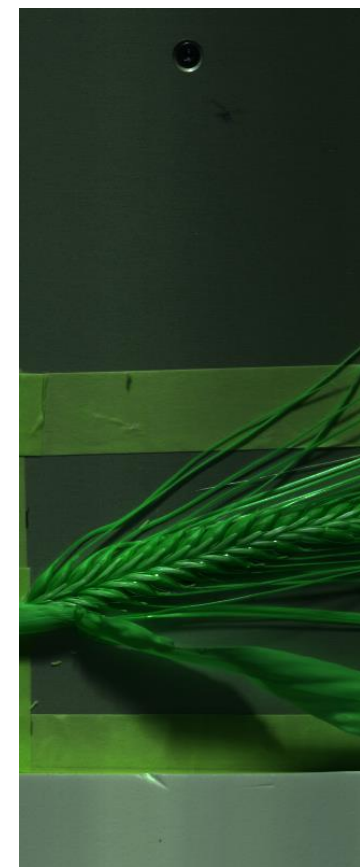
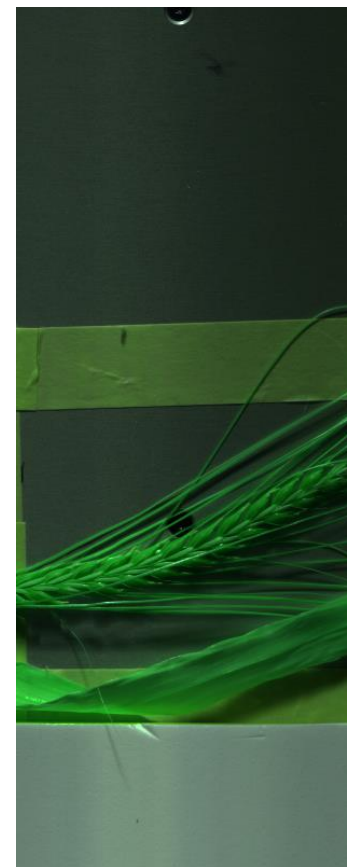
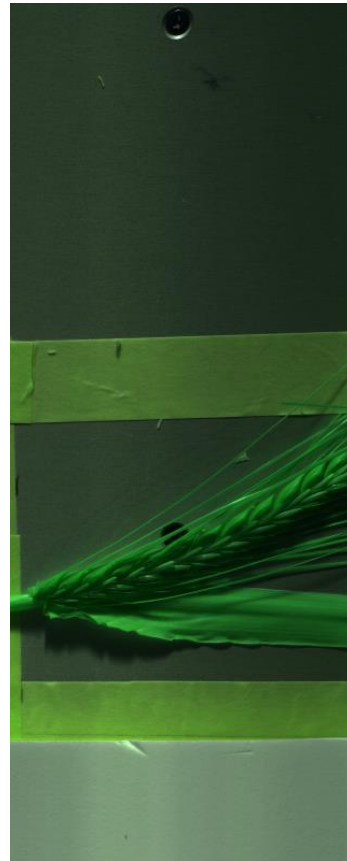
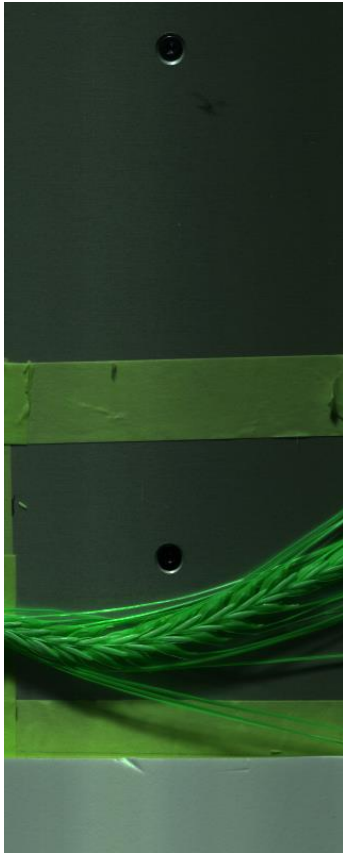
USING THREE CHANNELS (SWIR)

- Only region where spikes located are kept for processing
- Channels used: 55, 41, 12
- Still many other combinations possible maybe with better result



SWIR RECOMMENDED CHANNELS IN HEADER FILE

80TH, 200TH AND 48TH



SEGMENTATION USING OPENCV



- Changing Color-space
 - Color Conversion
 - We use the function `cv2.cvtColor(input_image, flag)` where flag determines the type of conversion (e. g. `cv2.COLOR_BGR2HSV`).
- Applying mask
 - We use the function `cv2.inRange(HSV_converted_image, lower_bounds, upper_bounds)`
 - For HSV, Hue range is [0,179], Saturation range is [0,255] and Value range is [0,255]. Different softwares use different scales. So need to normalize these ranges.

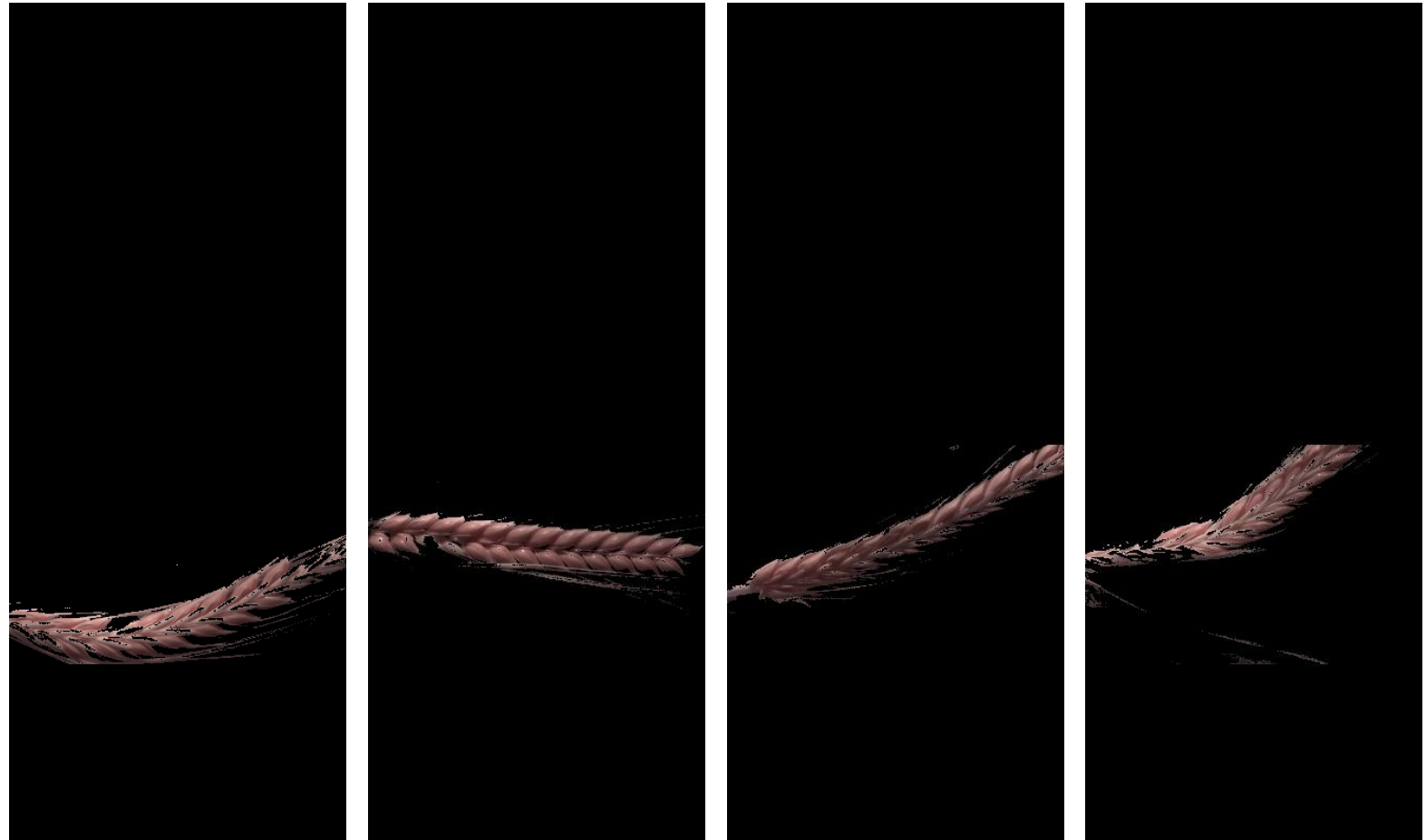


RESULT OF APPLYING MASK

- For HSV, Hue range is [0,179], Saturation range is [0,255] and Value range is [0,255]

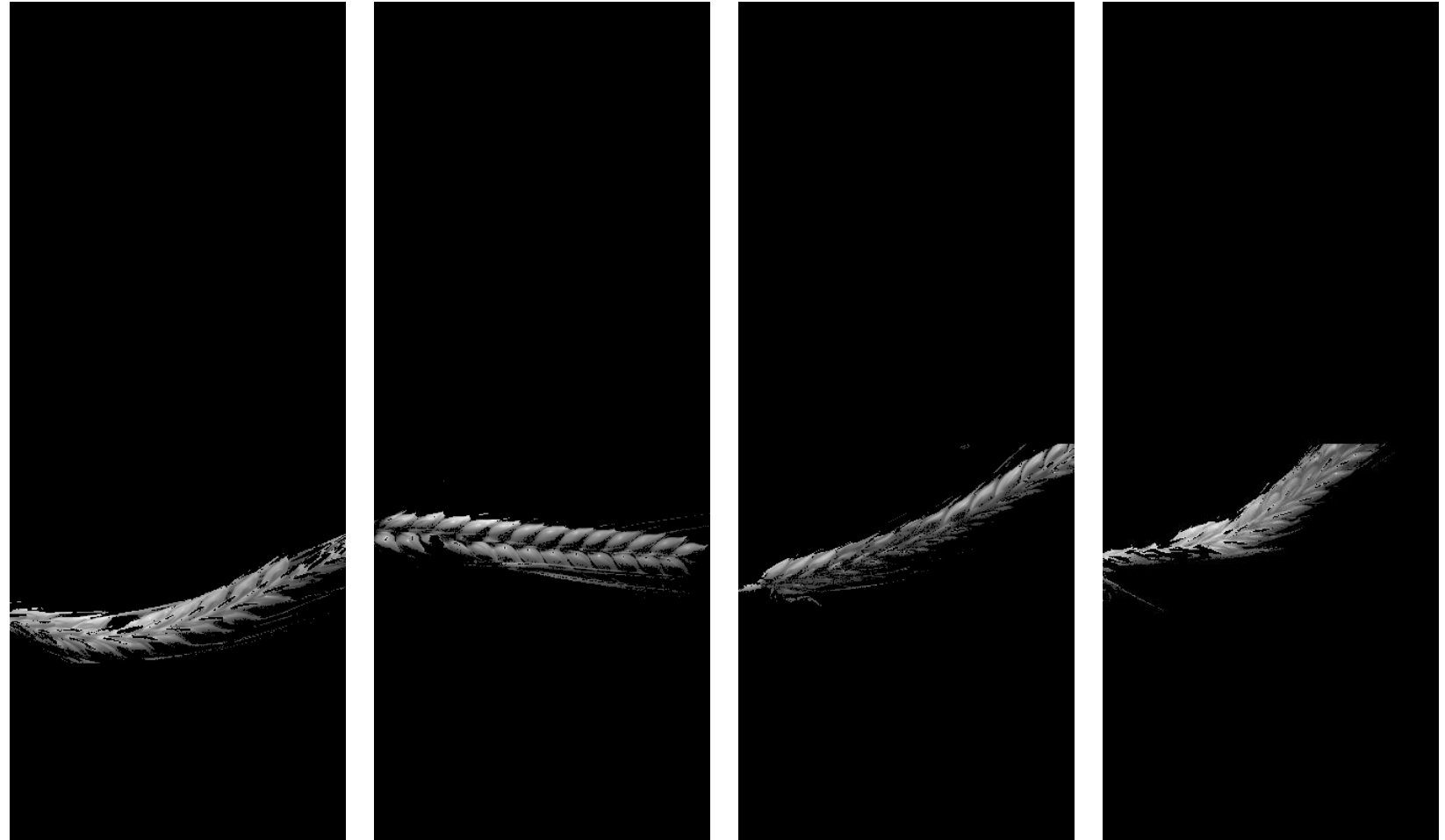
lower_bounds
(0, 60, 50)
upper_bounds
(100, 255, 255)

Leaves
removed



KEEPING ONLY SINGLE CHANNEL

Still it
contains
noises
around
grains

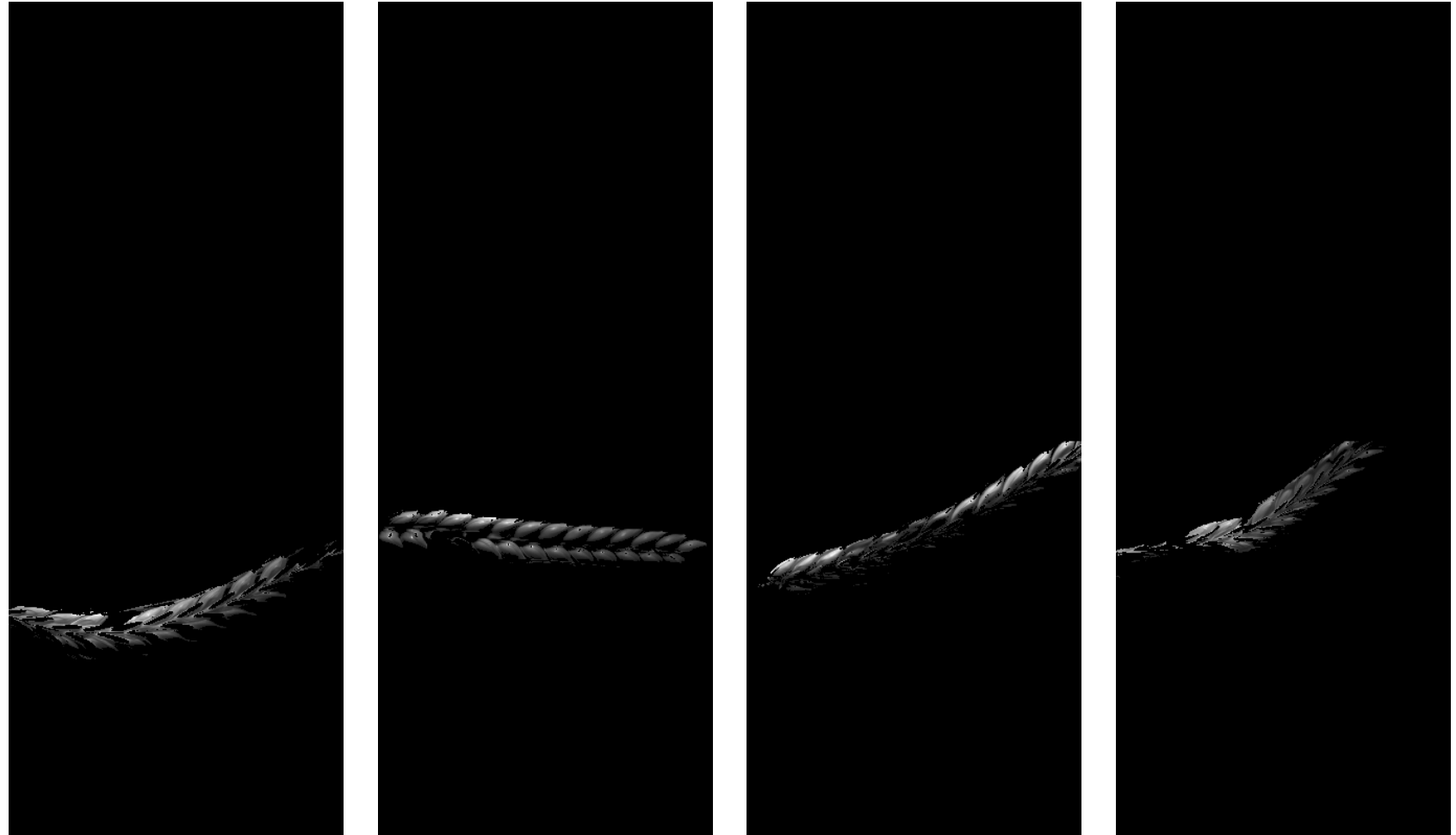


VARIABLE TRANSFORMATION

Goal:
keep grains well
separated

Approach:
Quadratic
transformation x^2
pushing back to the
range of 0-255

Pros:
can pick a global
threshold easier



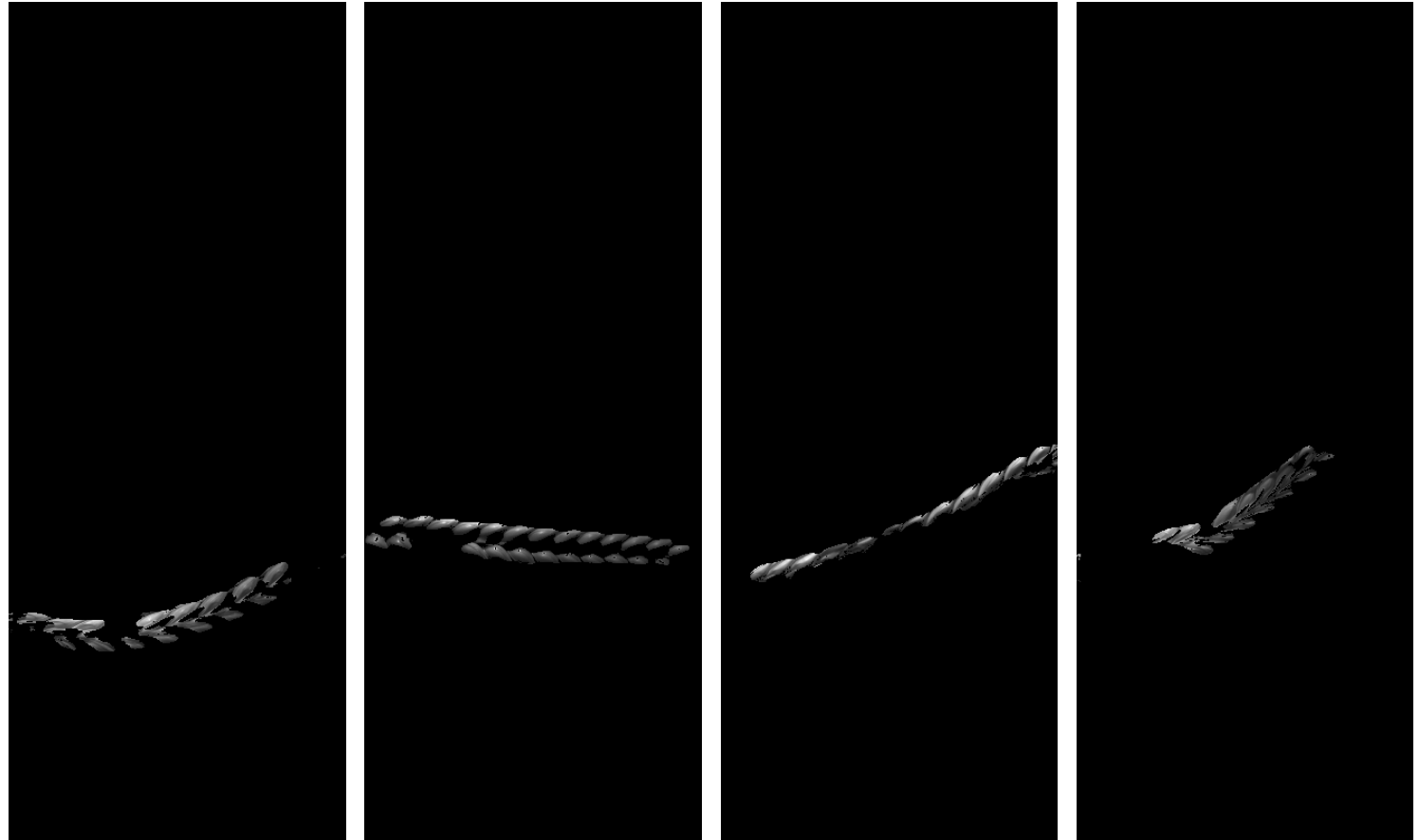
REMOVING NOISES: STRUCTURING ELEMENT

Radius = 5

Minimum points = 50

Radius is based on Moore neighborhood

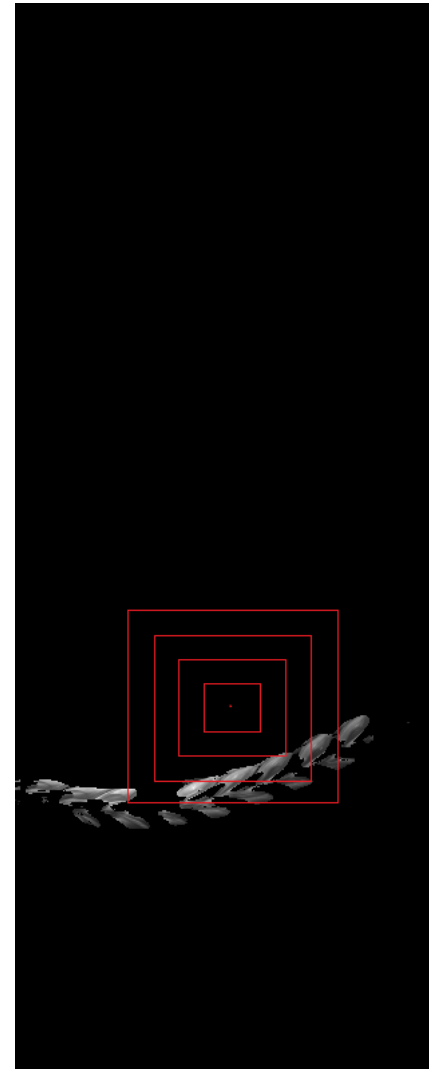
For any pixel, if the number of neighbors being equal or larger than minimum points (50), its kept otherwise its value is changed to zero.



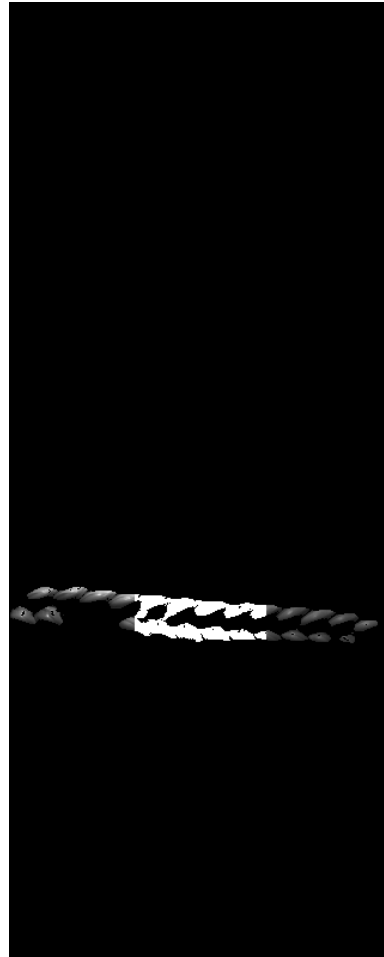
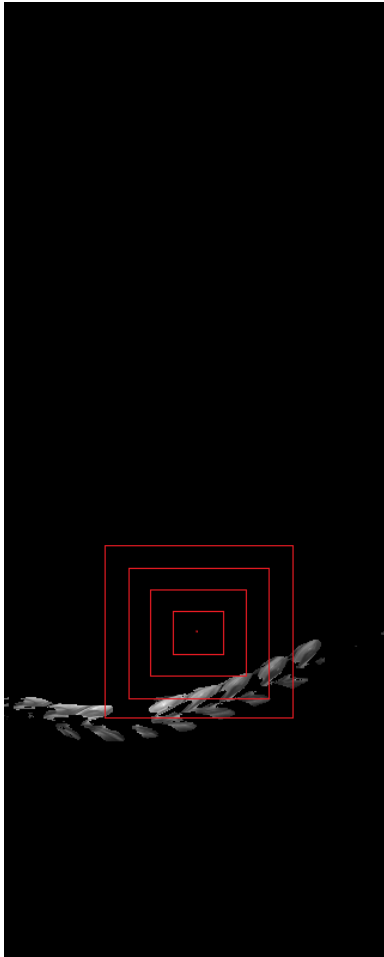
PICK GRAINS FROM MIDDLE OF SPIKE

started from middle point of area
where spikes are located and
expanded its area until we cover
2000 pixels

Each grain consist of around
20 X 20 pixels



PICK GRAINS FROM MIDDLE OF SPIKE

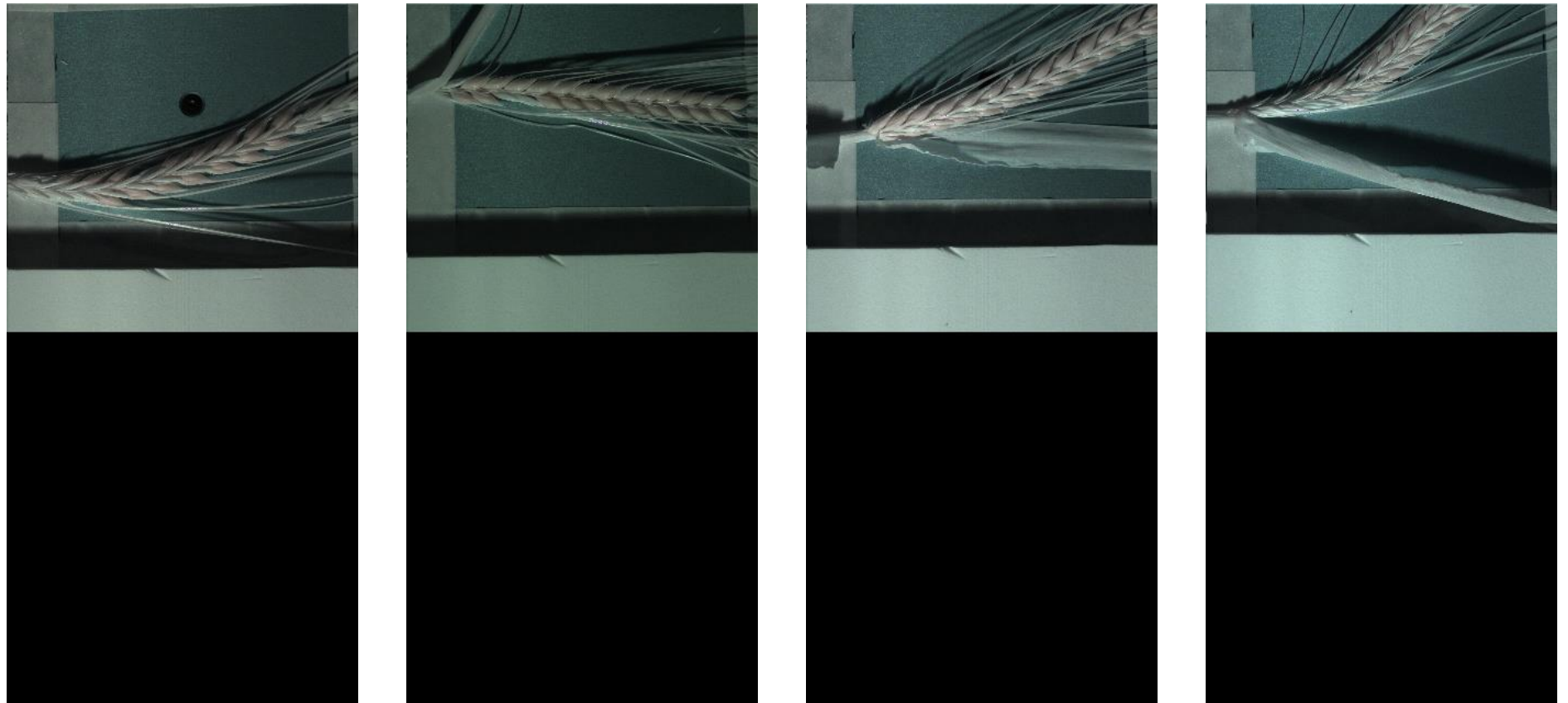


VNIR IMAGES

1600 x 3200

Three channels: 159, 152, 120

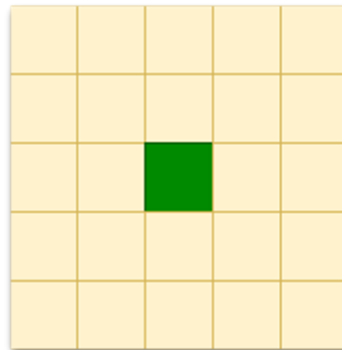
Only area where spikes are located are kept for processing



RESIZE VNIR

1600 x 3200

320 x 640

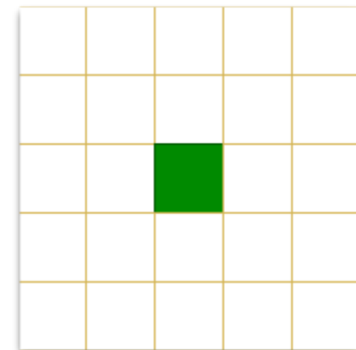


Mean

- High computation
- More than 30 min for single image (i5, 8GB ram)

Median

- Take less amount of time
- Around 3 min

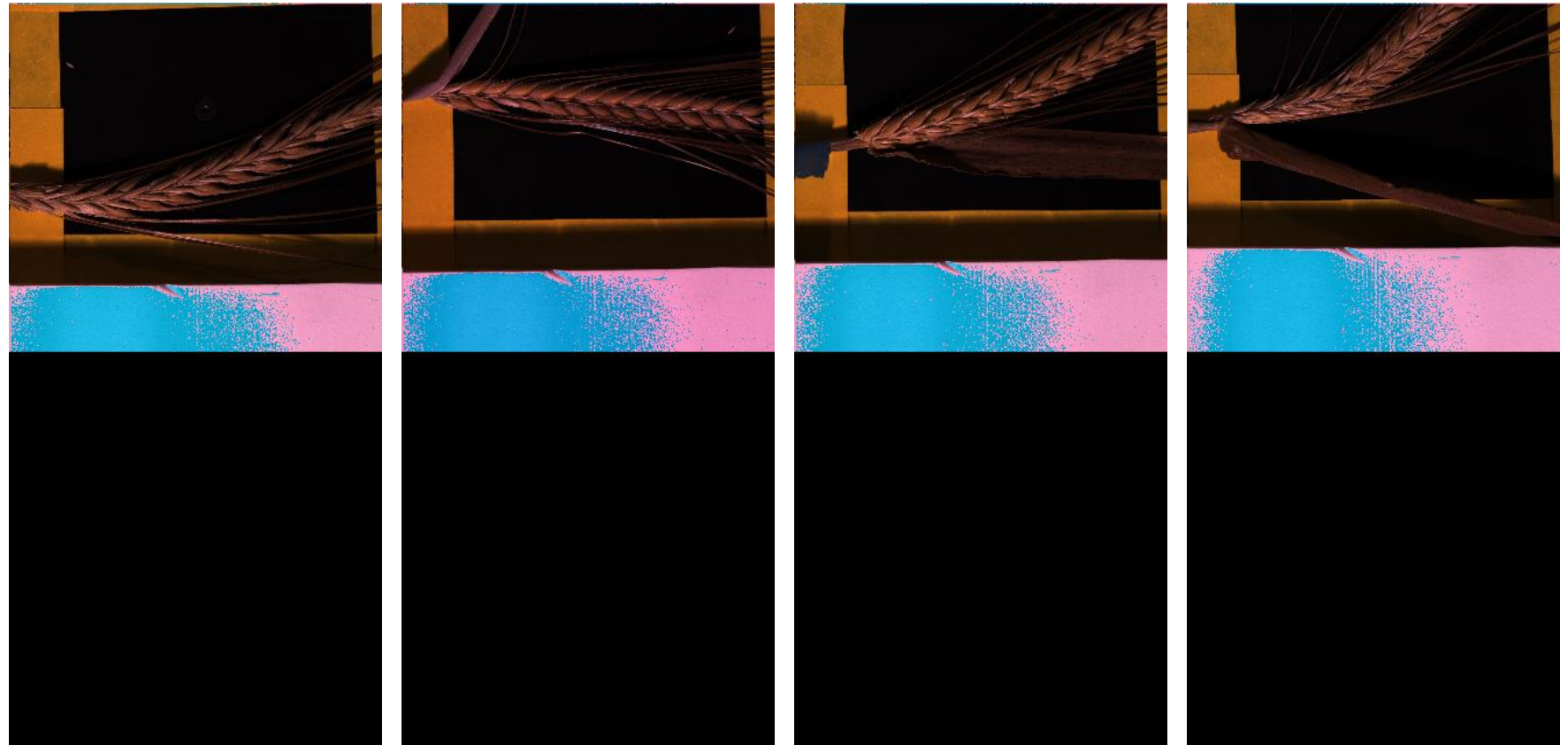


VNIR IMAGES

320 x 640

Three channels: 23, 31, 39

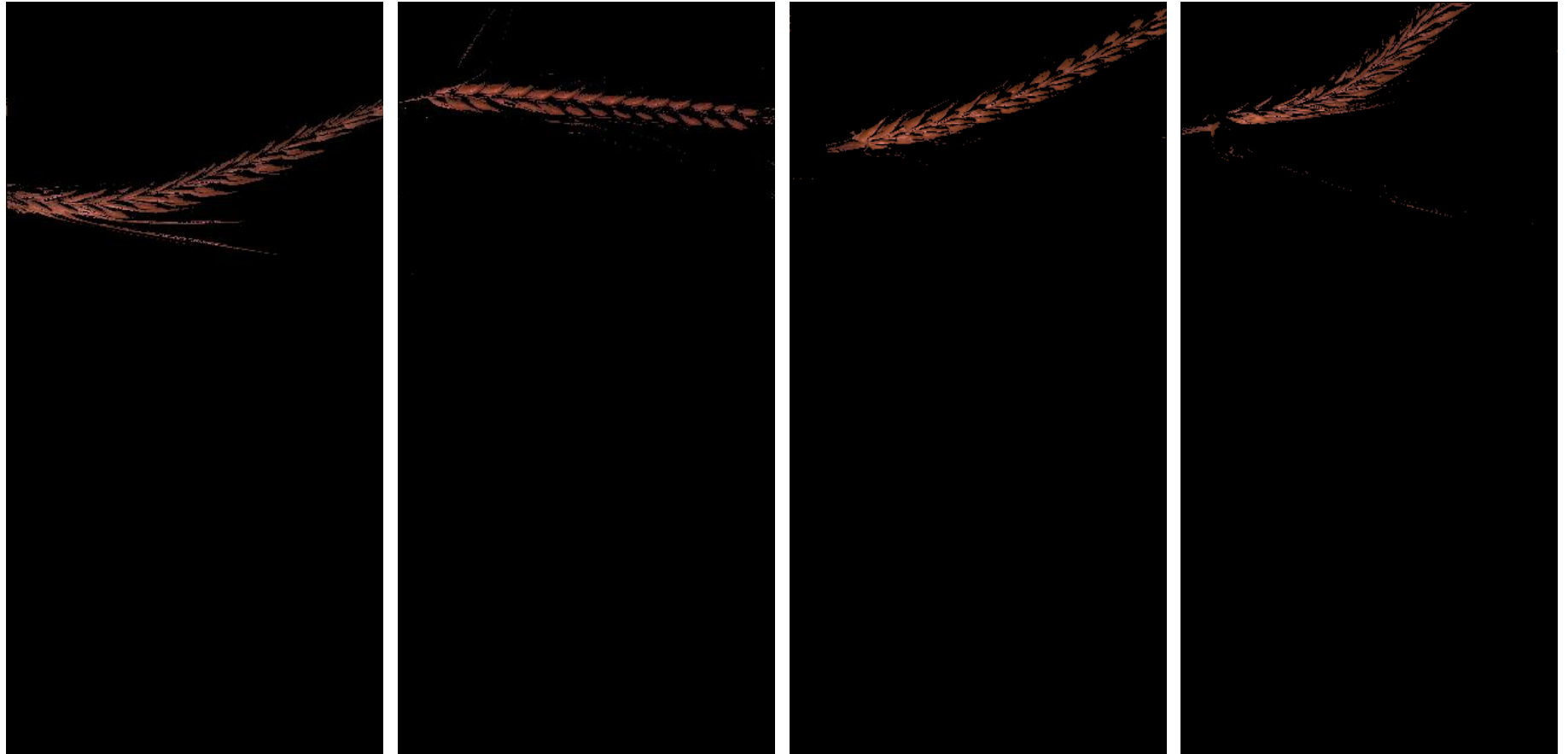
Only area where spikes are located are kept for processing



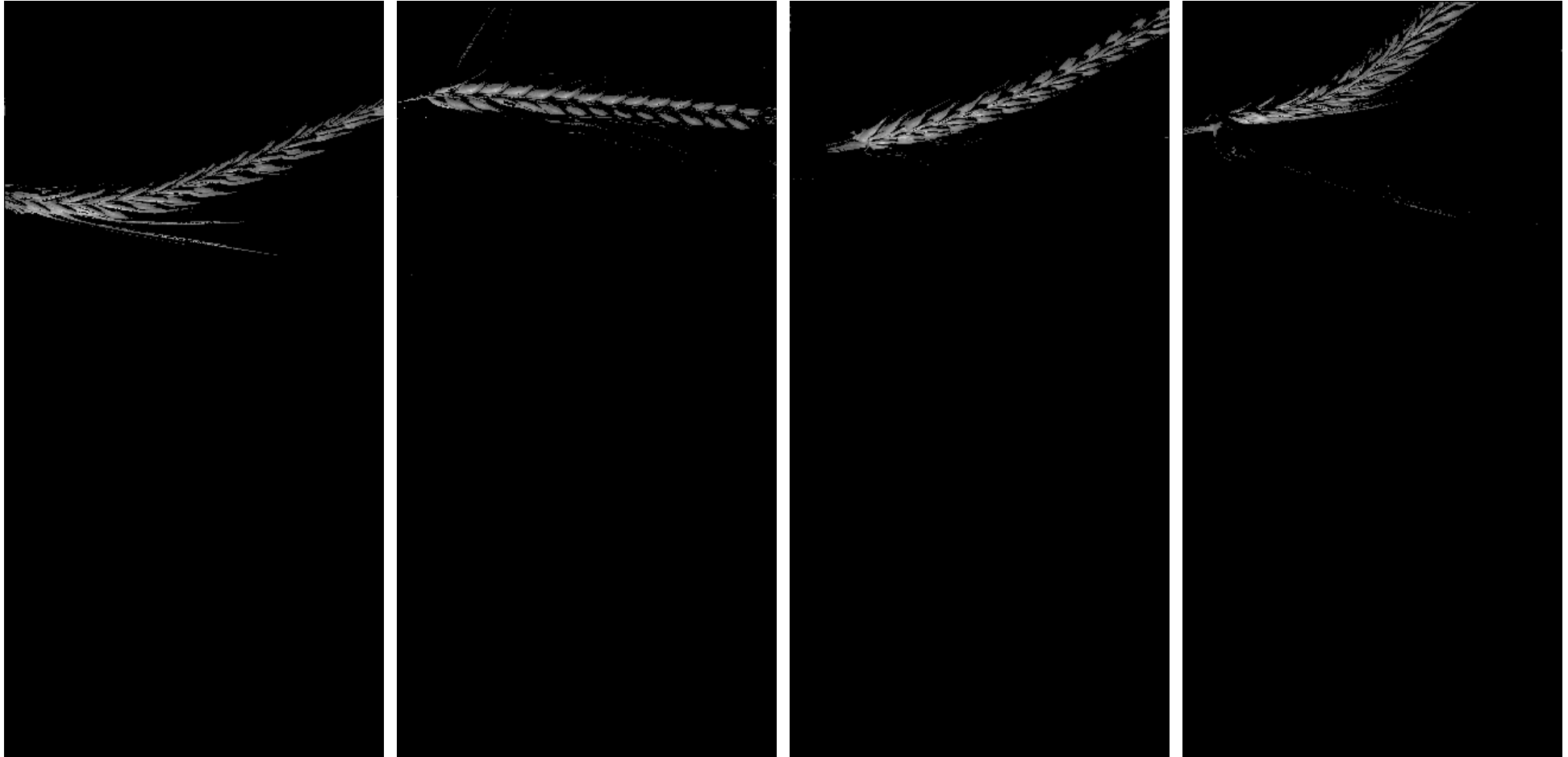
AFTER APPLYING MASK

lower_bounds:
(0, 0, 80)

upper_bounds:
(10, 250, 255)

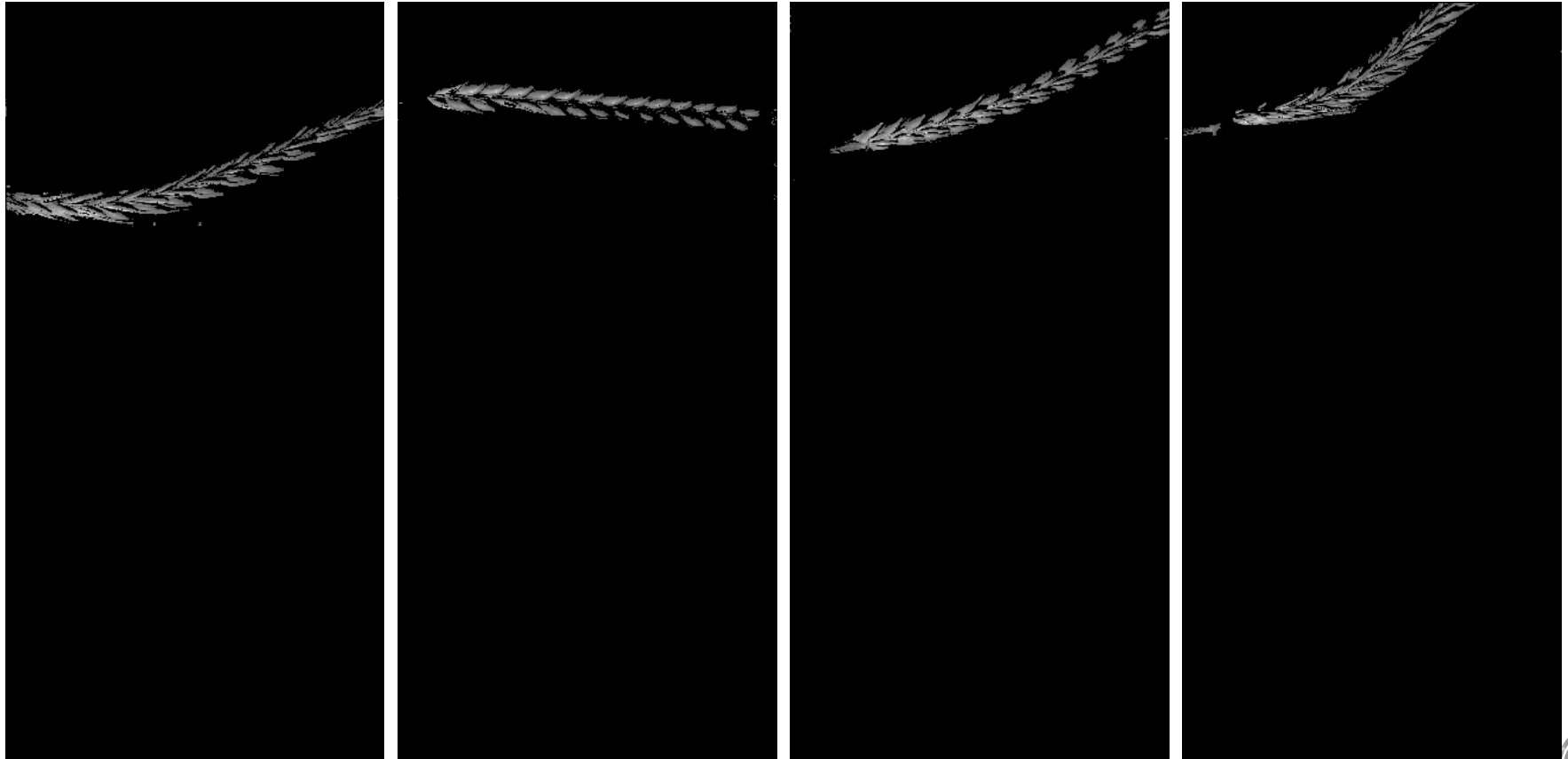


KEEPING ONLY SINGLE CHANNEL

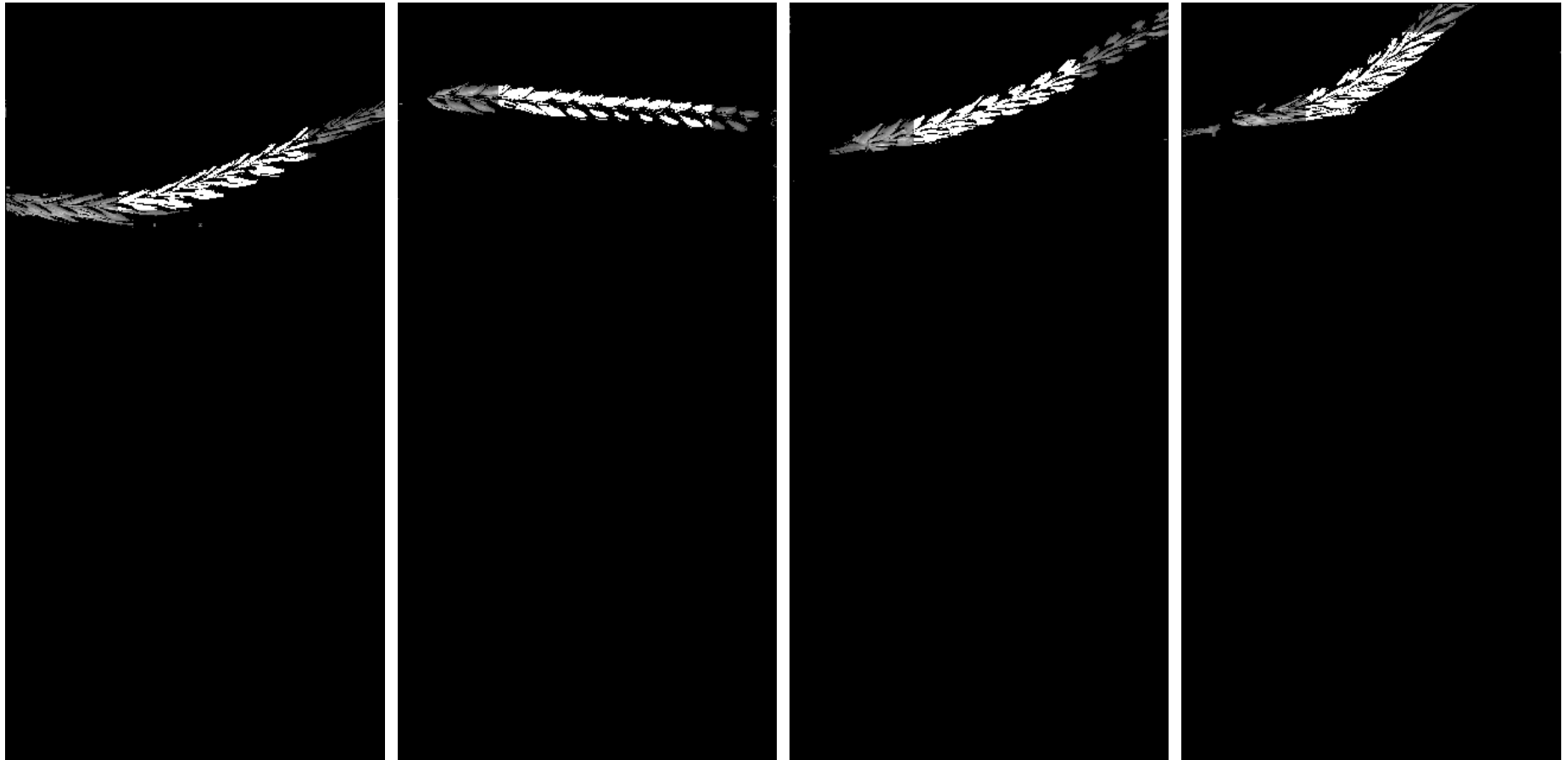


REMOVING NOISES: STRUCTURING ELEMENT

- Radius = 5
- Minpoints = 20
- Iterations: 2



KEEPING MIDDLE GRAINS OF SPIKE



COMPARING BOTH IMAGES

$$A \cap B$$

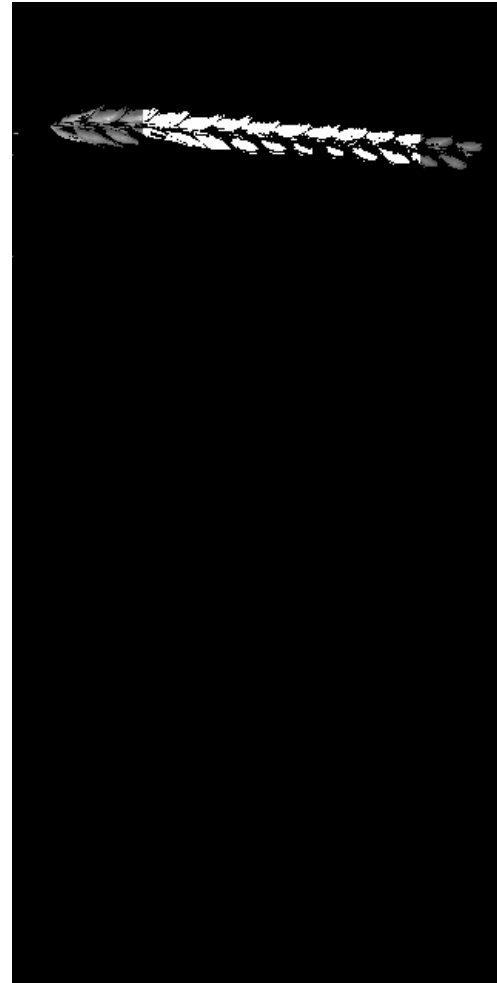
Will result around 1000 variables
Is it sufficient?



COMPARING BOTH IMAGES

$$A \cap B$$

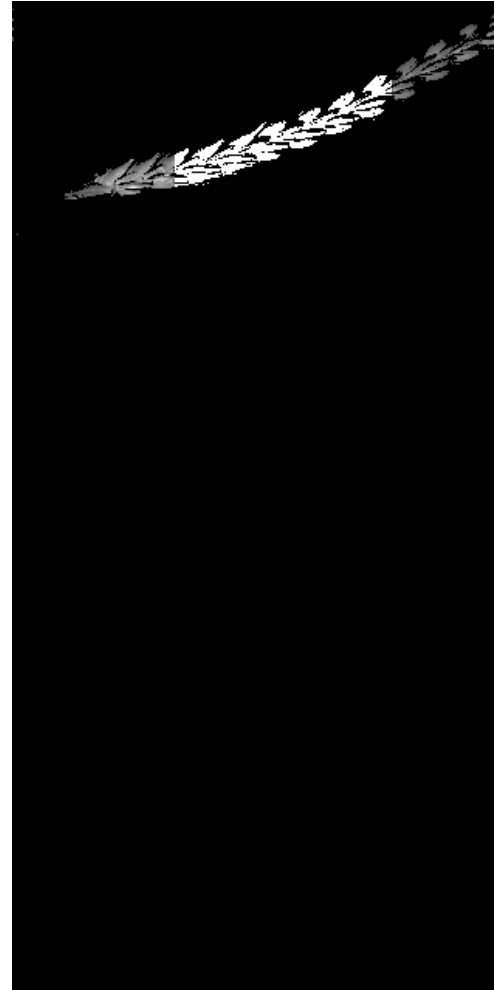
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COMPARING BOTH IMAGES

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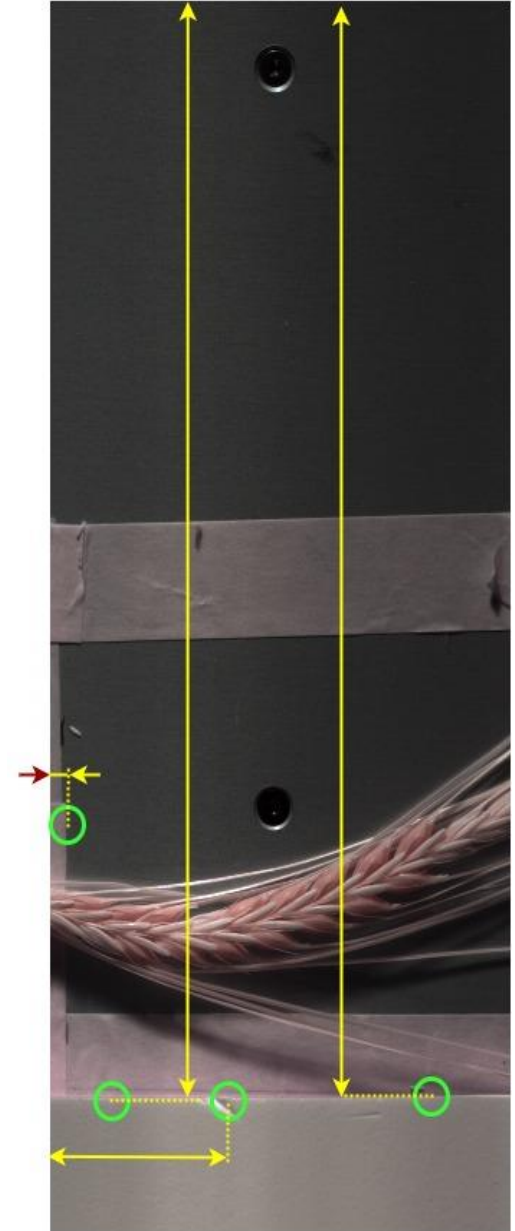
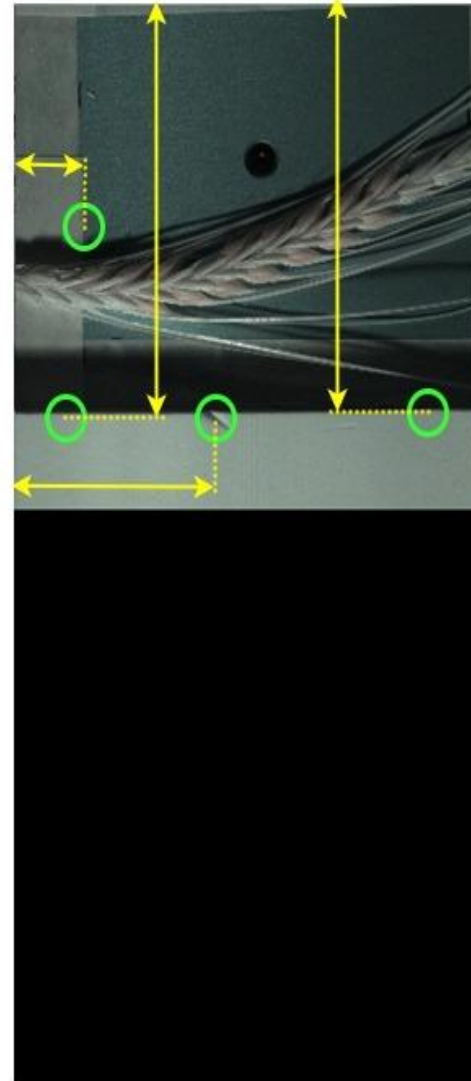
Will result around 1000 variables
Is it sufficient?



MERGING BOTH IMAGES

Segmenting four points to merge images such that:

- Find starting coordinates for both images
- Measure level of zooming
- Measure rotation if there be any



DATASET (BASED ON MEAN, ST.DV)

Img_Name	Channel_no	Mean	std.dev	T_01	...	T_N
Img001	1					
Img001	...					
Img001	416					
...						
...						
Img460	1					
Img460	...					
Img460	416					



SECOND DATASET

(MERGING SWIR AND VNIR BASED ON COORDINATES)

Img_Name	X	Y	Ch_001	Ch_002	...	Ch_416	T_01	...	T_N
Img001									
Img001									
Img001									
Img001									
Img001									
Img001									
...									
Img460									
Img460									
Img460									
Img460									
Img460									
Img460									



PROJECT STATUS

Tasks	Expected Date	Done	Assigned to
Literature Research	12.Dec.2019	Yes	All team members
Segmentation	01.Mar.2020	Yes	Saied
Management of Data (downloading images and resizing VNIR images)	05.Mar.2020	Yes	Ramkishore
Merging images	10.Mar.2020	Yes	Saied
Preparing Dataset	15.Mar.2020		Saied
AI model 1 (based separate data sets of each SWIR and VNIR images)	01.Apr.2020		Amit, Ramkishore,
AI model 2 (based on mean and std.dev of merged SWIR and VNIR)	01.Apr.2020		Devish, Sudheer
AI model 3	01.Apr.2020		Saied
AI model 3	01.Apr.2020		Raman
Comparing Algorithms	...		Saied, Amit, Raman
Documentation	...		Amit, Raman, Ramkishore, Sudheer, Devish

