

Technical Working Party on Testing Methods and Techniques

TWM/1/4

First Session

Virtual meeting, September 19 to 23, 2022

Original: English

Date: August 18, 2022

IMAGE ANALYSIS IN PLANT VARIETY TESTING

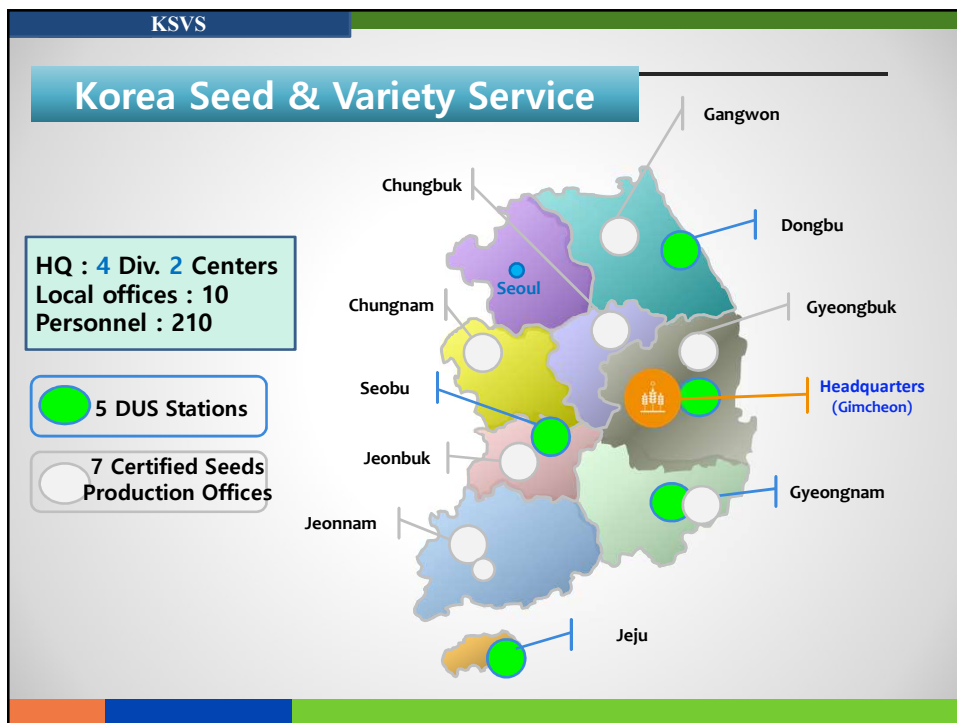
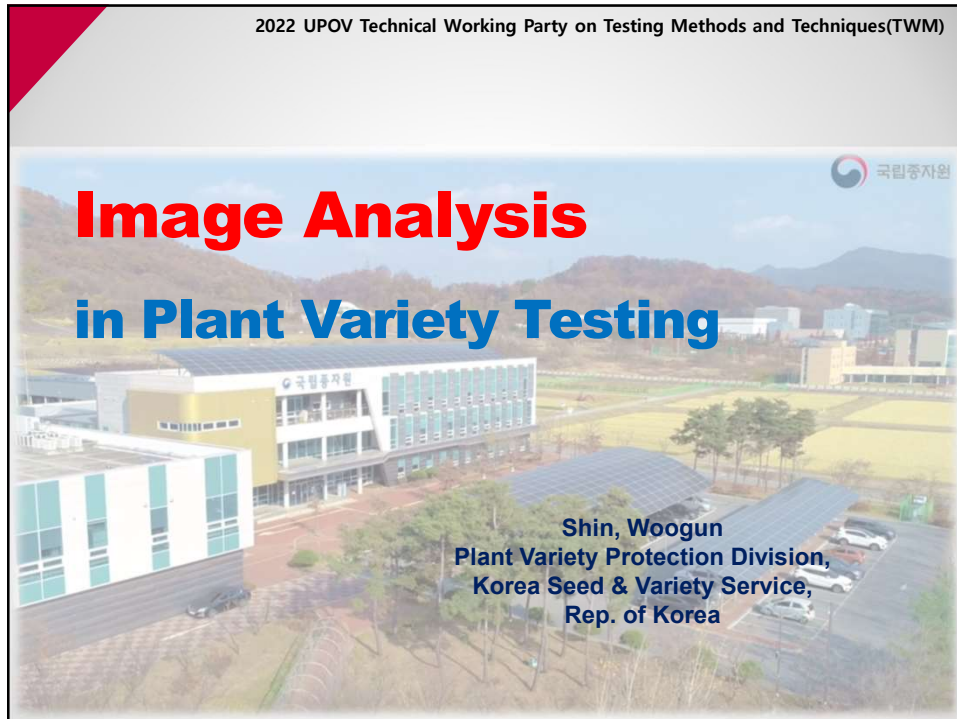
Document prepared by an expert from the Republic of Korea

Disclaimer: this document does not represent UPOV policies or guidance

The annex to this document contains a copy of a presentation on “Image Analysis in Plant Variety Testing”, prepared by an expert from the Republic of Korea, to be made at the first session of the TWM.

[Annex follows]

2022 UPOV Technical Working Party on Testing Methods and Techniques(TWM)





Why Image Analysis ?

2020

- * Application 646 var.
- * Growing Trials
(125 Crops, 1,946 var.)

The slide features a blue header with the title 'Why Image Analysis ?'. Below the title, the year '2020' is displayed in a large, bold font. Underneath, there are two bullet points: '* Application 646 var.' and '* Growing Trials (125 Crops, 1,946 var.)'. The background of the slide is a light gray, and there are decorative colored bars (orange, blue, and green) at the top and bottom edges.

Why Image Analysis ?



- Rose : 50 applications per year, 54 characters
- 6 hours per variety, depends on external conditions

Strategy for Image Analysis



Measurement (2020~2021)



Color
(2021~2022)



Shape (2022~2023)

[illegible]

We will change

As-Is

- ✓ Avg. time per variety : 376min.(6 hrs)
- ✓ Personal per variety: 2~3 persons
- ✓ 4 steps for DUS examination
 - ▲ Measuring and manual documentation
 - ▲ Taking photos for reports
 - ▲ Manually data recording to the system
 - ▲ Data analysis

VS

To-Be

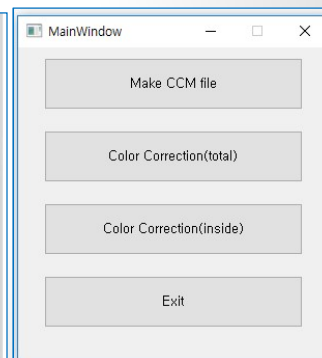
- ✓ 186min. (3 hrs)
- ✓ 1 persons
- ✓ 2 steps
 - ▲ Taking photos
 - ▲ Image analysis and data recording

Image Analysis

Photos by Camera, Mobile

Measurement

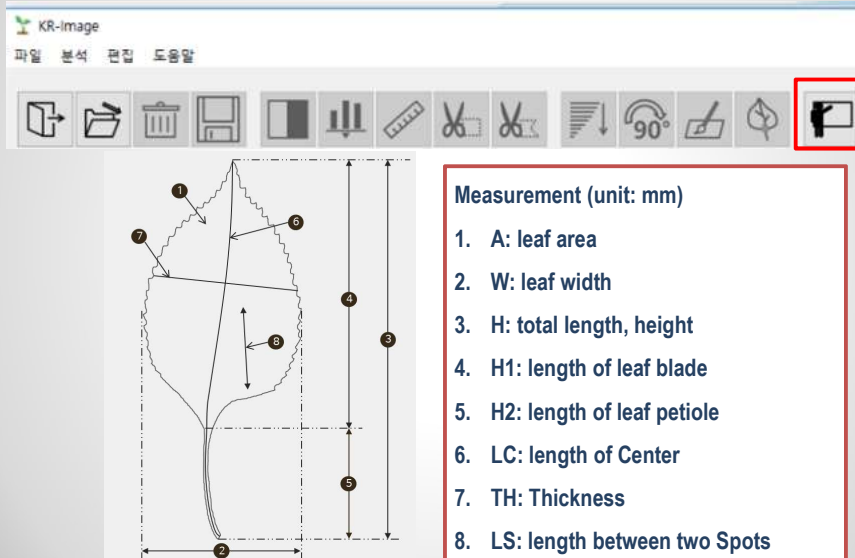
Color



1. Image Analysis for Measurement



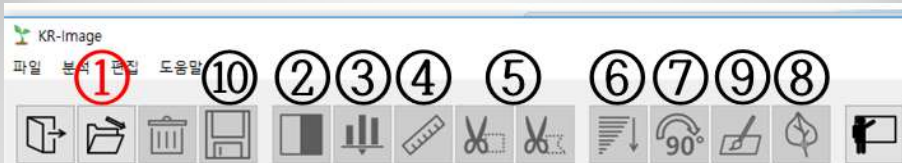
1. Image Analysis for Measurement



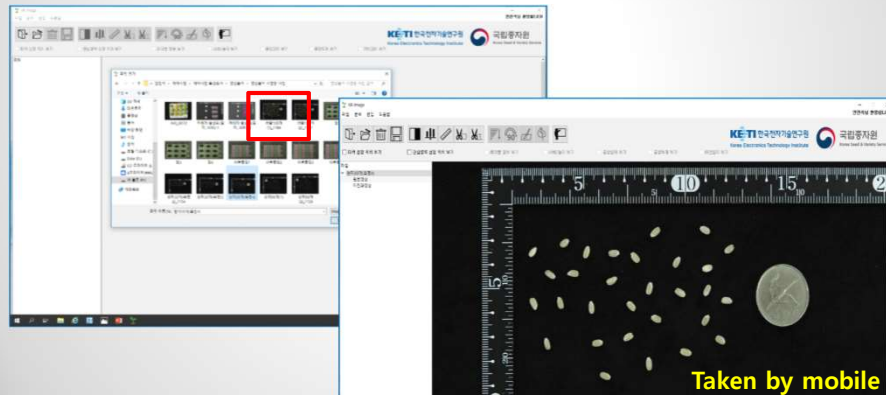
1. Image Analysis for Measurement

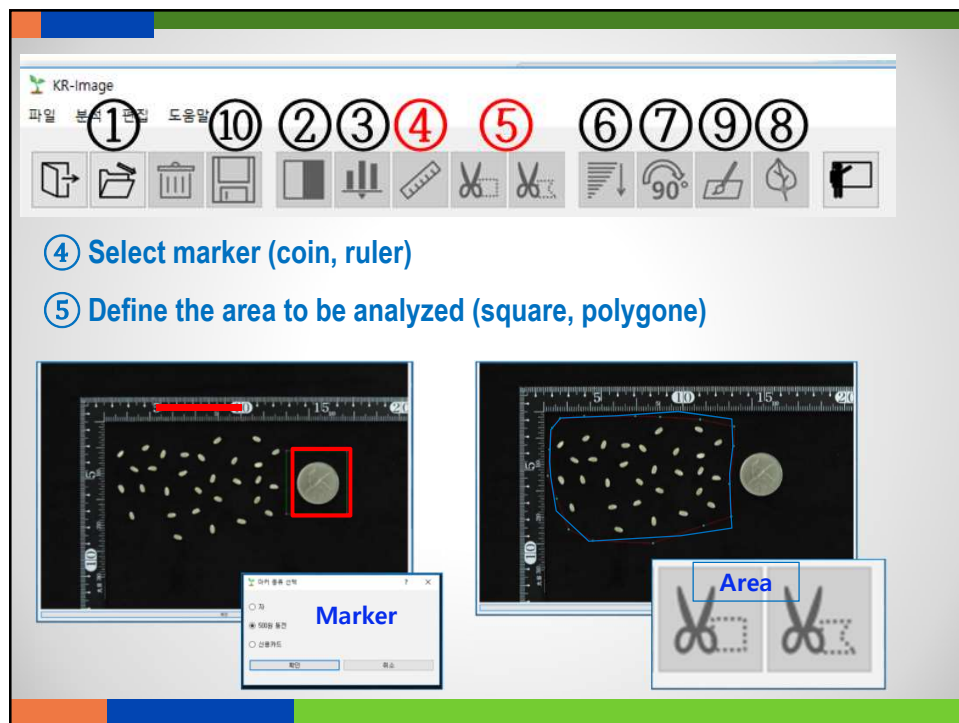
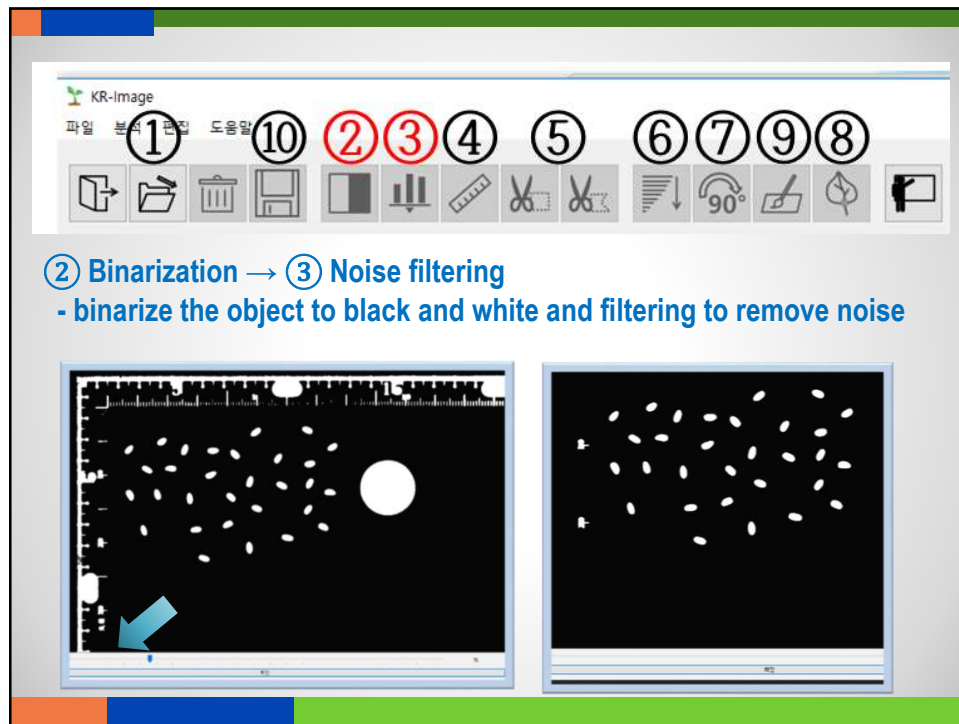


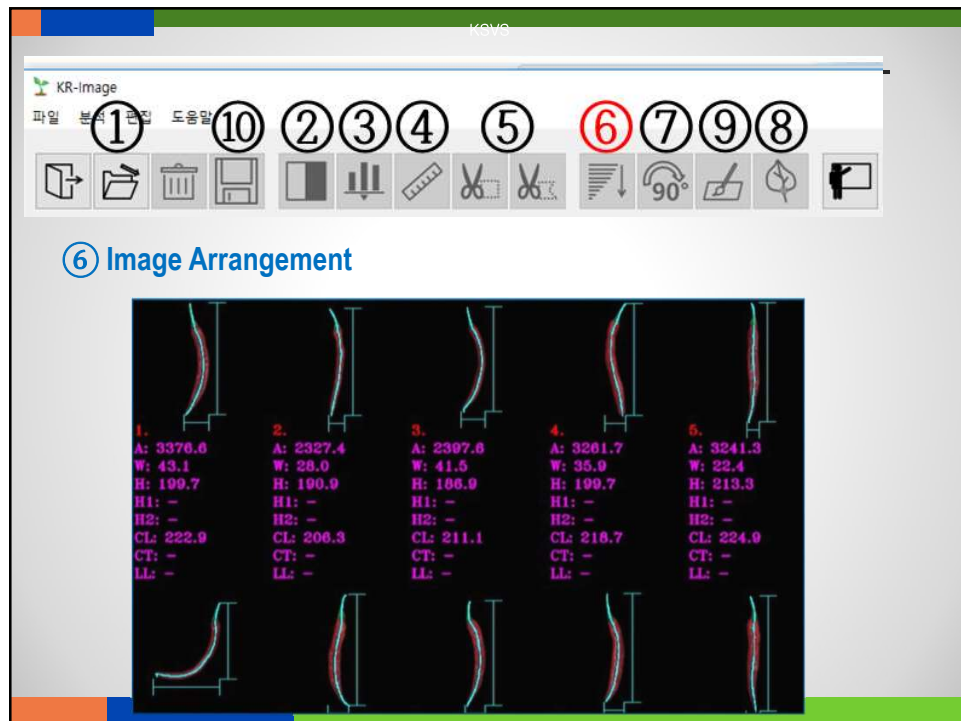
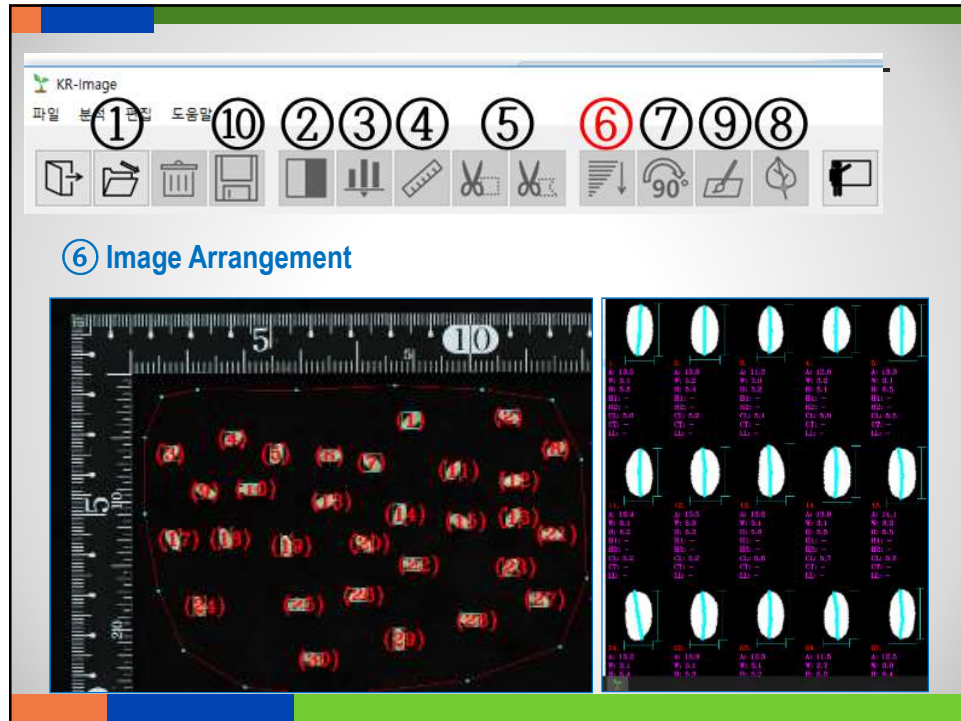
- ① Open file→②Binarization→③Noise filtering(noise) →
④Select marker(coin)→⑤Select area to be analyzed(plant)→
⑥Arrange image(analysis)→⑦Rotate objects→
⑧Select points to measure→⑨Edit image colors→
⑩Save results in excel format



① Open file (photo)







KR-Image

파일 편집 ① ⑩ ② ③ ④ ⑤ ⑥ ⑦ ⑨ ⑧

⑥ Image Arrangement

Taken by camera, indoors

Index	A	B	C	D
1	040.0	000.0	044.1	000.0
2	10.1	10.0	17.3	17.0
3	00.0	00.4	00.0	00.0
4	10.0	10.0	17.3	17.0
5	10.0	10.0	17.3	17.0
6	10.0	10.0	17.3	17.0
7	10.0	10.0	17.3	17.0
8	10.0	10.0	17.3	17.0
9	10.0	10.0	17.3	17.0
10	10.0	10.0	17.3	17.0
11	10.0	10.0	17.3	17.0
12	10.0	10.0	17.3	17.0
13	10.0	10.0	17.3	17.0
14	10.0	10.0	17.3	17.0
15	10.0	10.0	17.3	17.0

KR-Image

파일 편집 ① ⑩ ② ③ ④ ⑤ ⑥ ⑦ ⑨ ⑧

⑩ Save results in excel file

[2021_11_29_16_53_51]2.원미 30-1_원본영상

[2021_11_29_16_53_51]2.원미 30-1_이진화영상

[2021_11_29_16_53_51]2.원미 30-1_정렬영상

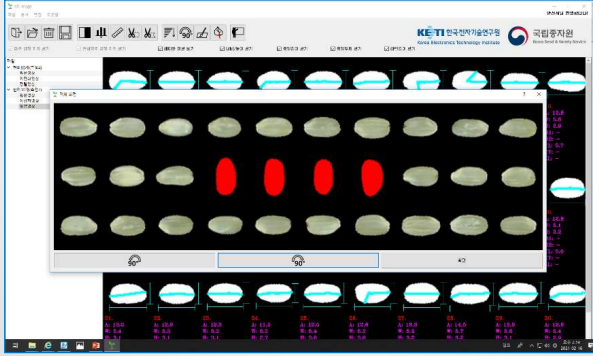
[2021_11_29_16_53_51]result_data

	A	B	C	D
1	crop index	area(mm²)	width(mm)	height(mm)
2	1	17.9	5.9	6.2
3	2	17.7	5.9	5.8
4	3	15.8	5.9	5.6
5	4	16.4	4.1	5.3
6	5	17.5	5.9	5.8
7	6	17.9	5.9	6.0
8	7	19.0	4.4	6.0
9	8	16.6	5.9	5.8
10	9	16.8	5.7	6.0
11	10	17.2	5.7	6.0
12	11	16.6	5.9	5.6
13	12	18.5	4.1	6.0
14	13	17.9	5.7	6.0
15	14	18.3	4.1	6.0
16	15	19.0	4.1	6.2
17	16	16.9	5.9	5.8
18	17	19.3	4.1	6.0
19	18	17.1	5.9	5.6
20	19	17.5	5.9	6.0
21	20	17.4	4.1	5.8
22	21	18.1	5.9	6.0
23	22	17.2	5.9	5.8
24	23	16.7	5.7	5.6
25	24	15.7	5.7	5.6
26	25	17.0	5.7	5.8
27	26	17.0	5.9	5.6
28	27	17.9	5.9	5.8
29	28	19.6	5.9	6.5
30	29	18.9	4.1	6.0
31	30	17.1	5.7	5.8
32	average	17.5	5.9	5.9

KR-Image

① ⑩ ② ③ ④ ⑤ ⑥ ⑦ ⑨ ⑧

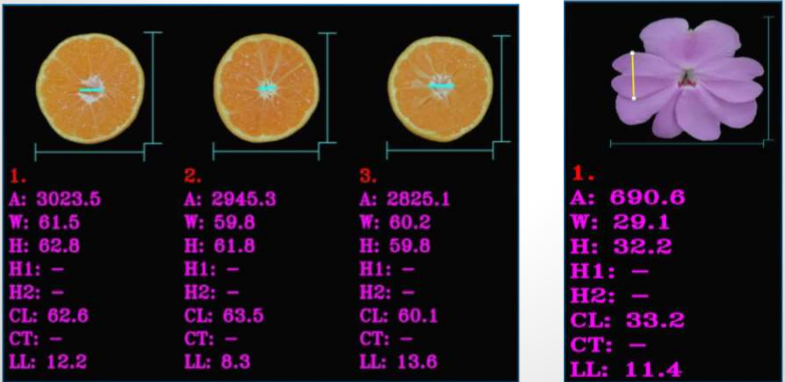
⑦ Rotate objects- individually or entirely at an angle of 90°



KR-Image

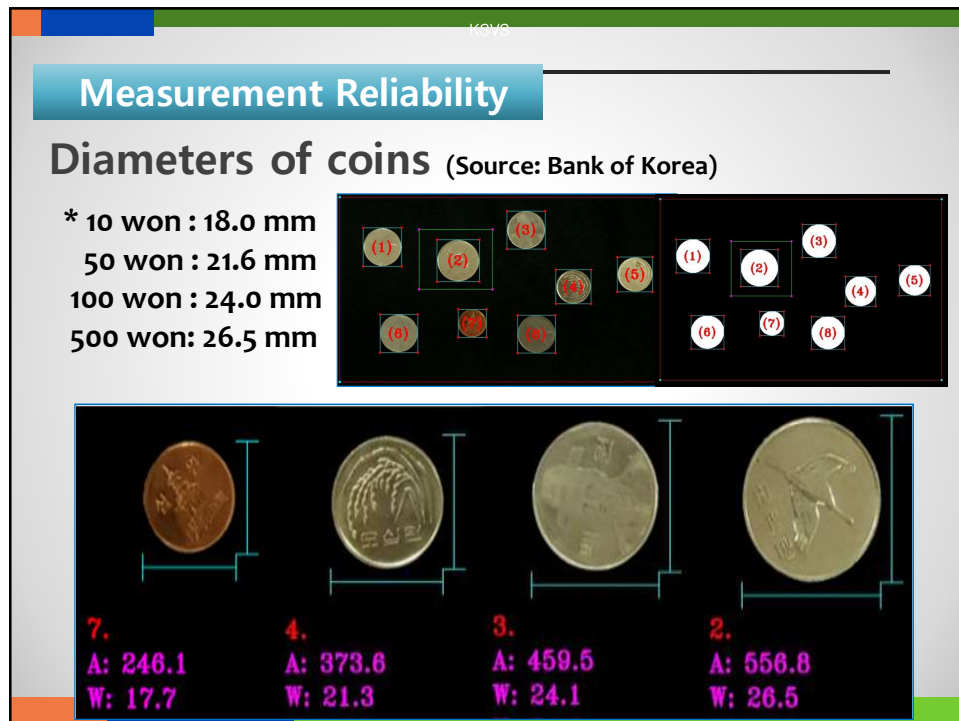
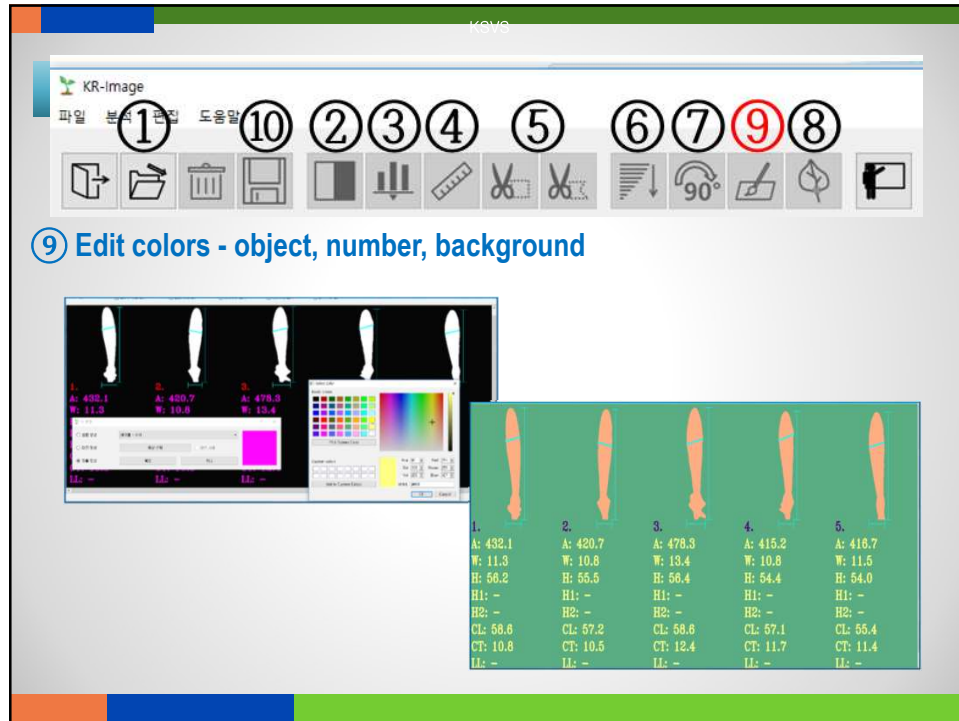
① ⑩ ② ③ ④ ⑤ ⑥ ⑦ ⑨ ⑧

⑧ Select target points
- thickness and distance between two dots



1.	2.	3.
A: 3023.5	A: 2945.3	A: 2825.1
W: 61.5	W: 59.8	W: 60.2
H: 62.8	H: 61.8	H: 59.8
H1: -	H1: -	H1: -
H2: -	H2: -	H2: -
CL: 62.6	CL: 63.5	CL: 60.1
CT: -	CT: -	CT: -
LL: 12.2	LL: 8.3	LL: 13.6

1.
A: 690.6
W: 29.1
H: 32.2
H1: -
H2: -
CL: 33.2
CT: -
LL: 11.4



Education for Breeders and Researchers



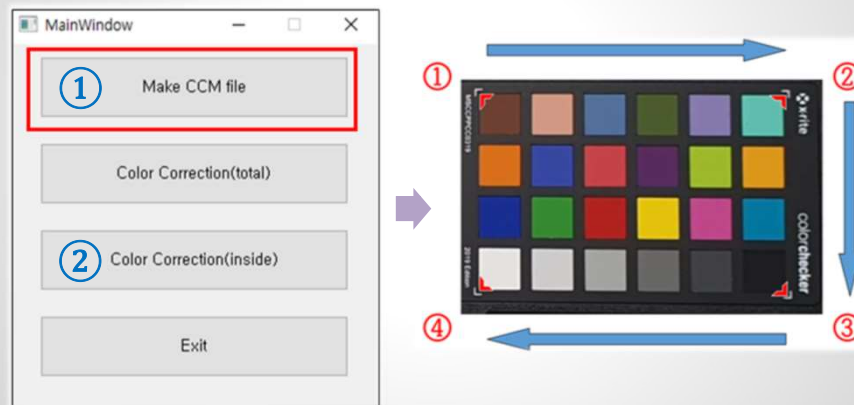
2. Image Analysis for Colors

- RGB DB of "RHS Color Chart" 920 colors
- "Color checker for correction" 24 colors

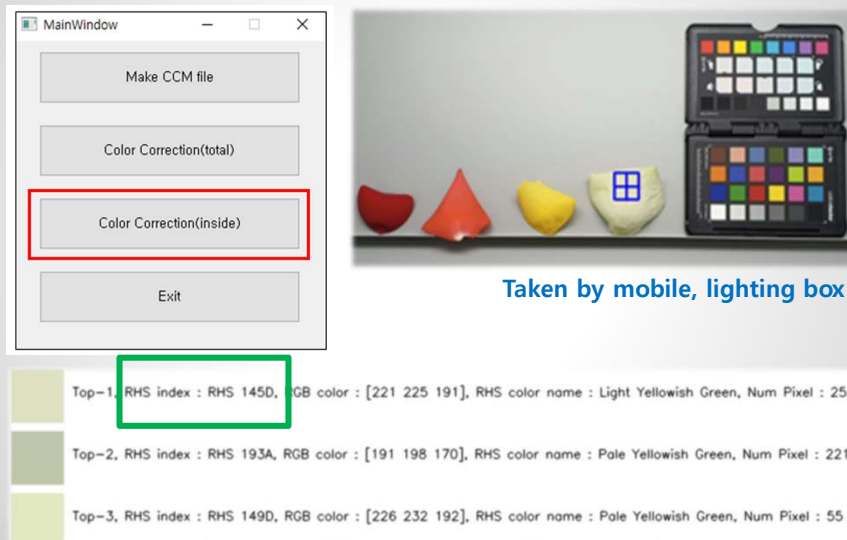


2. Image Analysis for Colors

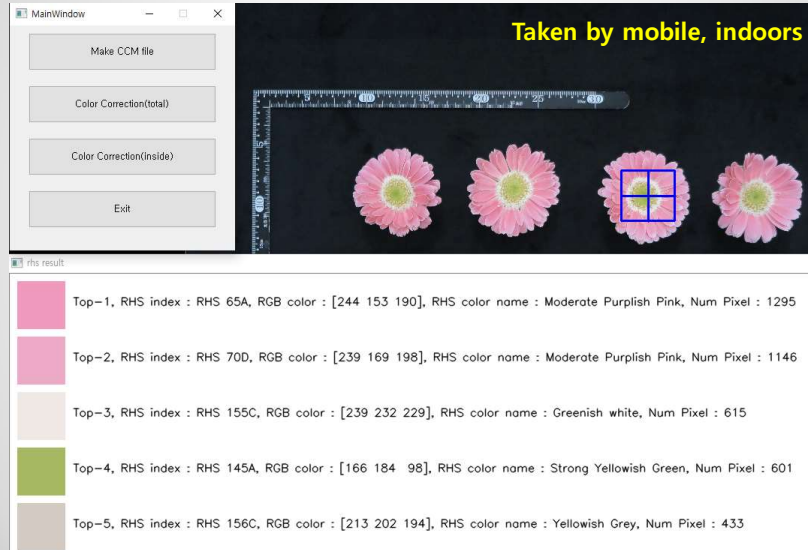
Make “Color Correction Matrix” File



2. Image Analysis for Colors



2. Image Analysis for Colors



2. Image Analysis for Colors



Taken by mobile, indoors

Top-1, RHS index : RHS 7A, RGB color : [246 215 60], RHS color name : Brilliant Yellow, Num Pixel : 549
Top-2, RHS index : RHS 151A, RGB color : [186 179 66], RHS color name : Strong Greenish Yellow, Num Pixel : 404
Top-3, RHS index : RHS 151B, RGB color : [198 192 54], RHS color name : Strong Greenish Yellow, Num Pixel : 341
Top-4, RHS index : RHS 153A, RGB color : [174 159 47], RHS color name : Deep Greenish Yellow, Num Pixel : 294
Top-5, RHS index : RHS 144A, RGB color : [118 138 59], RHS color name : Strong Yellowish Green, Num Pixel : 219

2. Image Analysis for Colors

5. 첨부자료

1. 출원종종(핑크페이)와 대조종종의 빛면 비교



Taken by camera, greenhouse, 2019



번호	특성	표현형태	계급	출원종종	대조종종
22	꽃잎 : 너비 (cm)	중간	5	2.3	6
23	꽃잎 : 두께	넓다	7		2.6
24	꽃잎 : 주요색			69B	52A
25	꽃잎 : 2차색			60A	-

ms result

- Top-1, RHS index : RHS 42A, RGB color : [199 58 58], RHS color name : Vivid Reddish Orange, Num Pixel : 507
- Top-2, RHS index : RHS 50A, RGB color : [213 65 81], RHS color name : Strong Red, Num Pixel : 456
- Top-3, RHS index : RHS 52A, RGB color : [225 77 93], RHS color name : Vivid Red, Num Pixel : 342
- Top-4, RHS index : RHS 45A, RGB color : [179 52 60], RHS color name : Vivid Red, Num Pixel : 308
- Top-5, RHS index : RHS 55A, RGB color : [240 106 138], RHS color name : Deep Purplish Pink, Num Pixel : 100

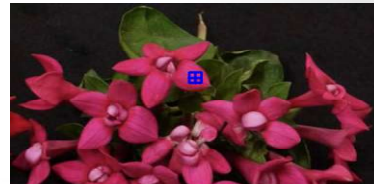
2. Image Analysis for Colors

2. 출원종종과 대조종종의 꽃자색 비교



Taken by camera, greenhouse, 2018

번호	특성	표현형태	계급	출원종종	대조종종
22	꽃잎 : 너비 (cm)	중간	5	8.8	8.6
23	꽃잎 : 두께	단색	1		1
24	꽃잎 : 주요색	2차 이상	2	45B	106A
25	꽃잎 : 2차색			-	-

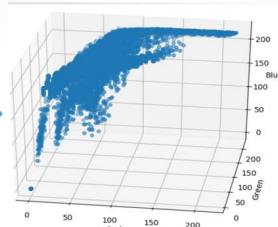


- Top-1, RHS index : RHS 45B, RGB color : [191 38 59], RHS color name : Vivid Red, Num Pixel : 102
- Top-2, RHS index : RHS 46B, RGB color : [184 41 58], RHS color name : Vivid Red, Num Pixel : 78
- Top-3, RHS index : RHS 46C, RGB color : [208 56 74], RHS color name : Vivid Red, Num Pixel : 56
- Top-4, RHS index : RHS 44A, RGB color : [158 0 39], RHS color name : Moderate Red, Num Pixel : 19
- Top-1, RHS index : RHS 66B, RGB color : [219 54 125], RHS color name : Vivid Purplish Pink, Num Pixel : 49
- Top-2, RHS index : RHS 66A, RGB color : [214 44 111], RHS color name : Vivid Purplish Pink, Num Pixel : 42
- Top-3, RHS index : RHS 61B, RGB color : [186 50 99], RHS color name : Strong Purplish Red, Num Pixel : 20
- Top-4, RHS index : RHS 60B, RGB color : [164 45 84], RHS color name : Strong Purplish Red, Num Pixel : 19

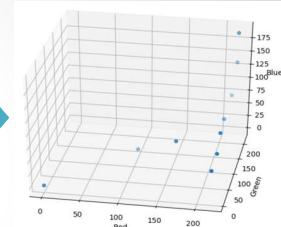
2. Image Analysis for Colors



**Designated
Color Area**
(칼라영역 지정)

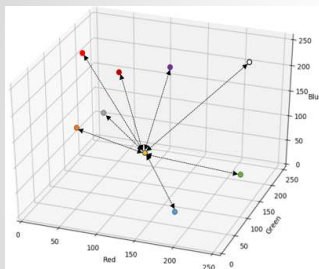
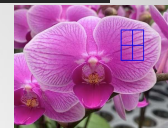


**1
Analysis of RGB
of all pixels**
(모든 픽셀의 RGB 분석)



**2
Selection of
20 major RGBs**
(동일 색상 그룹화)

2. Image Analysis for Colors



**3
Matching most similar
RHS color chart numbers
with 20 major RGBs**
(가장 유사한 RHS 칼라번호 매칭)

Top-1, RHS index : RHS N80B, RGB color : [176 91 172], RHS color name : Strong Purple, Num Pixel : 1880
Top-2, RHS index : RHS N78C, RGB color : [189 107 175], RHS color name : Deep Purplish Pink, Num Pixel : 1777
Top-3, RHS index : RHS N78B, RGB color : [179 73 153], RHS color name : Strong Reddish Purple, Num Pixel : 1255
Top-4, RHS index : RHS N80C, RGB color : [192 132 191], RHS color name : Light Purple, Num Pixel : 1243
Top-5, RHS index : RHS N80D, RGB color : [203 148 203], RHS color name : Light Purple, Num Pixel : 583

**4
Recommendation of 5 colors
according to their areas**
(면적에 비례하여 5개의 색 추천)

Color Analysis Reliability




RED GROUP 4 P.: N45A N45



Red A

RED GROUP 3 P.: 41B, 1 P.: 41A 41



Strong Red B

YELLOW GROUP 4 P.: 7A 7



Yellow A

YELLOW-GREEN GROUP 3 P.: 145D, 1 P.: 145C 145



Light Yellow Green D

Top-1, RHS index : RHS 198B, RGB color : [166 162 155], RHS color name : Light Greenish Grey, Num Pixel : 5496

Top-2, RHS index : RHS N45A, RGB color : [158 0 39], RHS color name : Moderate Red, Num Pixel : 1723


Top-3, RHS index : RHS 145C, RGB color : [209 214 159], RHS color name : Light Yellowish Green, Num Pixel : 1648

Top-4, RHS index : RHS 41A, RGB color : [233 81 70], RHS color name : Vivid Reddish Orange, Num Pixel : 1570

Top-5, RHS index : RHS 7A, RGB color : [246 215 60], RHS color name : Brilliant Yellow, Num Pixel : 1315


3. Image Analysis for Shape

colong




Rounded set


ovale



elliptic




obovate

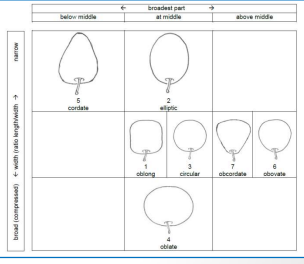


Angular set

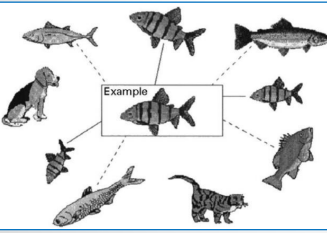
triangular



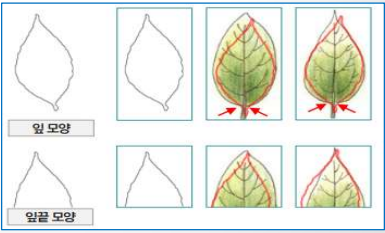
Shape Analysis Diagram



Example



Shape Analysis Diagram



Algorithm development : Template matching system



[End of Annex and of document]