Artificial Intelligence in Genebanks: Seed Multispectral Analysis for Germplasm Integrity and Targeted Breeding Traits

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Genebank capacity

- ICARDA's genebank holds 152223 accessions between Morocco and Lebanon, composed of cereals, legumes, forages, and wild species.

- In Morocco, 65694 accessions of cereal and 28565 accessions of legumes are actively available in the genebank.

- Through the years ICARDA's genebank has distributed 61000 samples to 37 countries, With an average of 5000 to 7000 samples per year.

Figure 1: Active collection - ICARDA genbank

Figure 2: Genetic diversity of cereals

Traits characterization

Table 1: Lentil descriptors used for manual seed characterization

Trait	Option
Colour of the pattern on testa	0-Absent;1-Olive;2-Grey;3-Brown;4-Black
Testa colour (ground colour of testa)	1-Green; 2-Grey;3-Brown;4-Black;5-Pink;6-Yellow
Testa pattern	0-Absent;1-Dotted;2-Spotted;3-Marbled;4-Complex
Seed width	3- Narrow; 5- Medium; 7- Broad
Seed shape in longitudinal section	1- Narrow elliptic; 2- Medium elliptic; 3- Broad elliptic

Genebank objectives through VideometerLab

- Turning characterization of ICARDA accessions from a destructive and resource-consuming operation to a fast and precise non-destructive process.

- Ensuring the optimum use of ICARDA's germplasm collection by providing a broader spectrum of data on each accession.

- Providing information about the germplasm's trait expression of highly heritable morphological and agronomical features.

- Identifying novel diversity and maintaining the genetic integrity of the regenerated germplasm.

- Combining data collected from multispectral image analysis and field characterization and making a primary portfolio as a base for researchers to decide on the genetic diversity to use for their selection.

Multispectral image analysis-VideometerLab 4

- Multispectral image acquisition through reflectance imaging, fluorescence, and transmittance imaging.

- Non-Destructive, and highly reproducible characterization of germplasm.

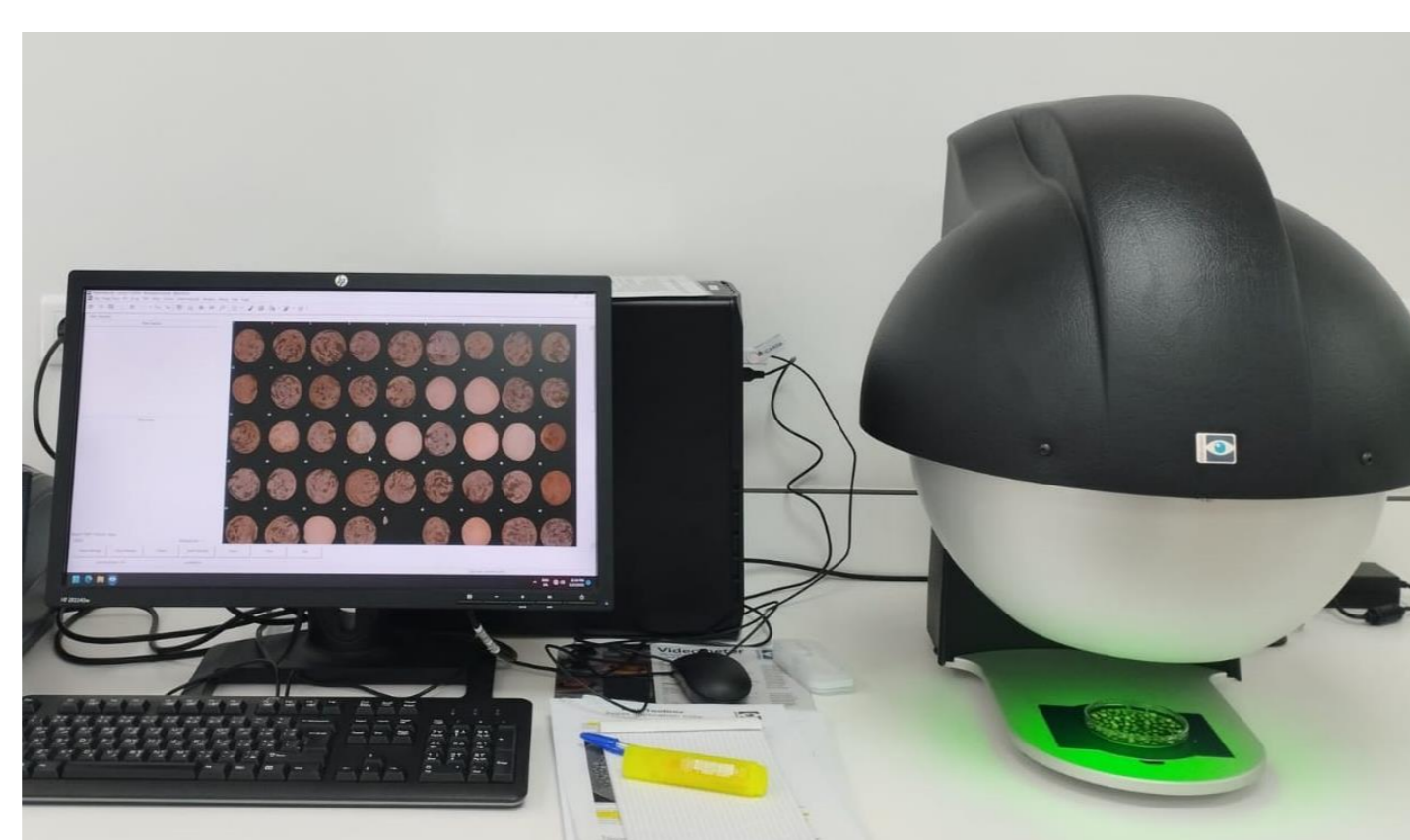- Broad spectrum for phenotypic and chemical analysis for the seeds.

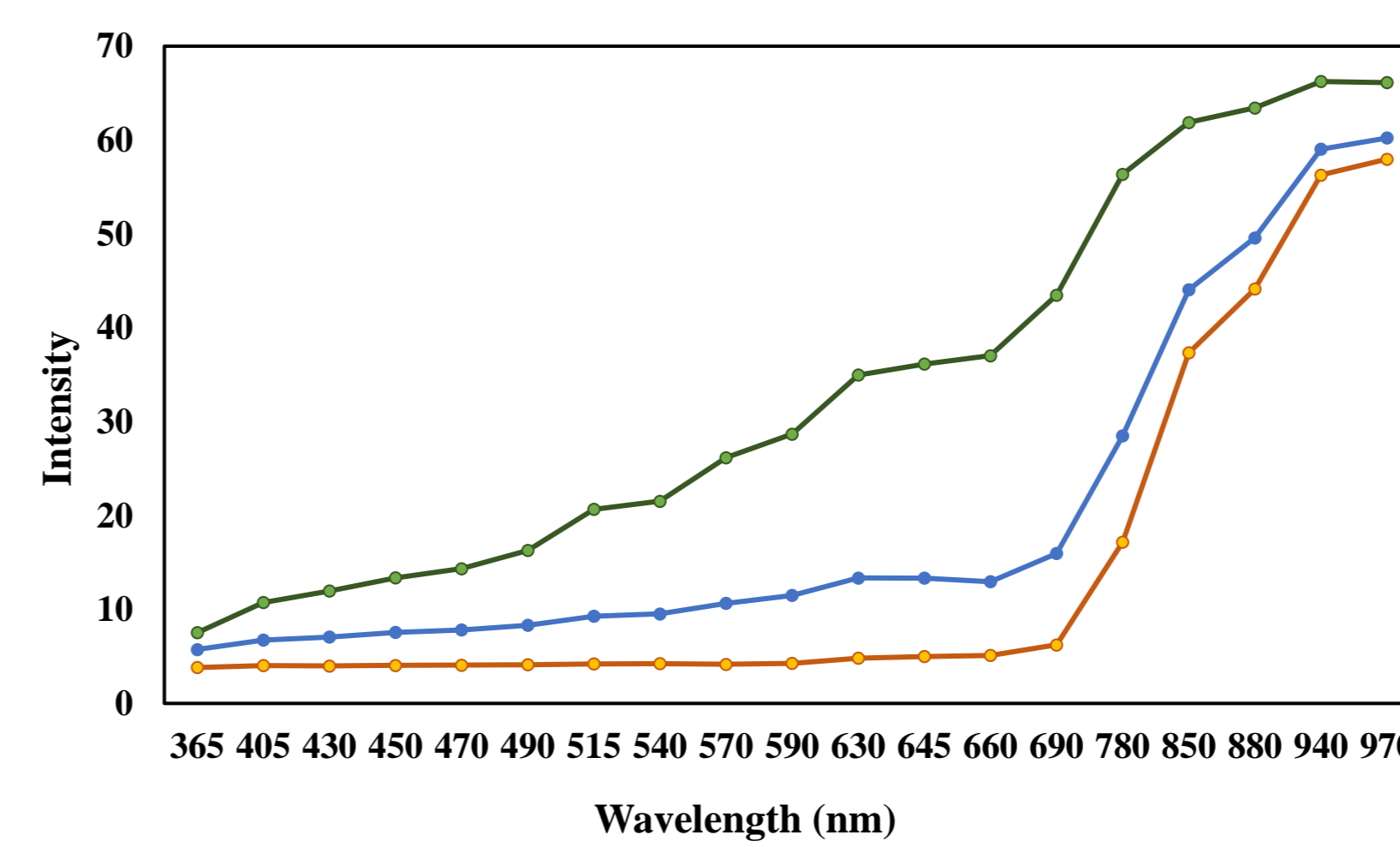**Figure 3:** VideometerLab 4

MSI Traits analysis

Figure 4: Lentil absorbtion intensity of 19 spectral bands in the range 365 nm to 970 nm
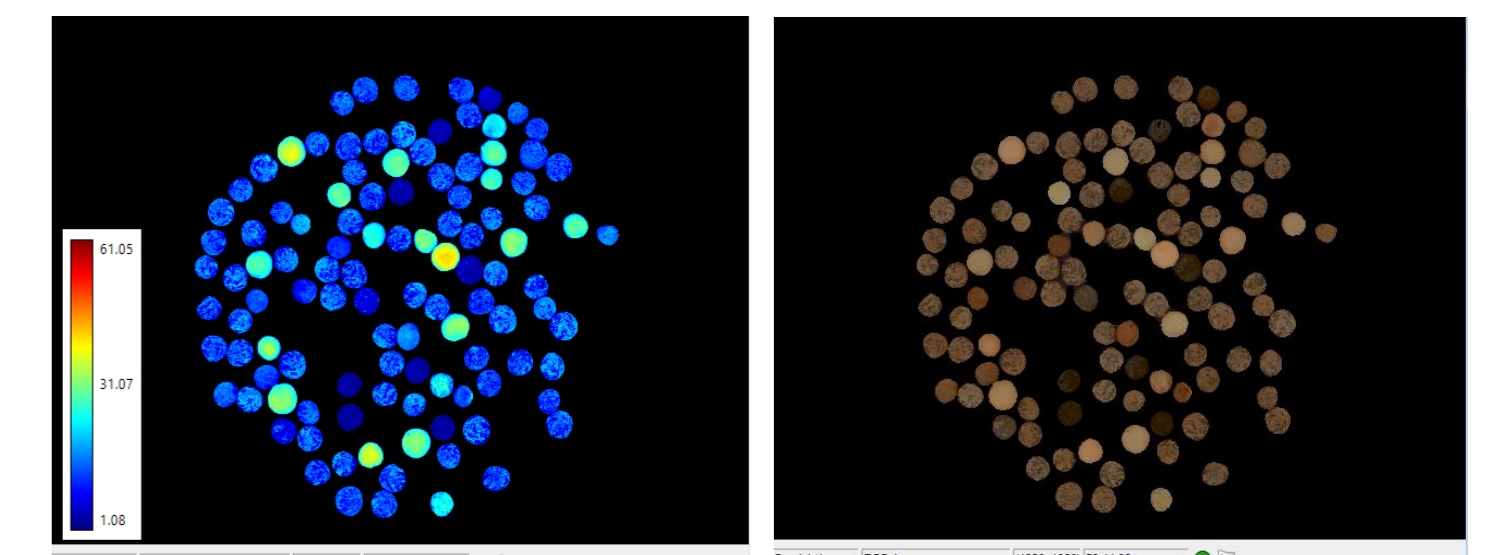

Figure 5: Lentil testa color intensity shown on Jet view with band 15 in Red 630nm

Blob tool analysis

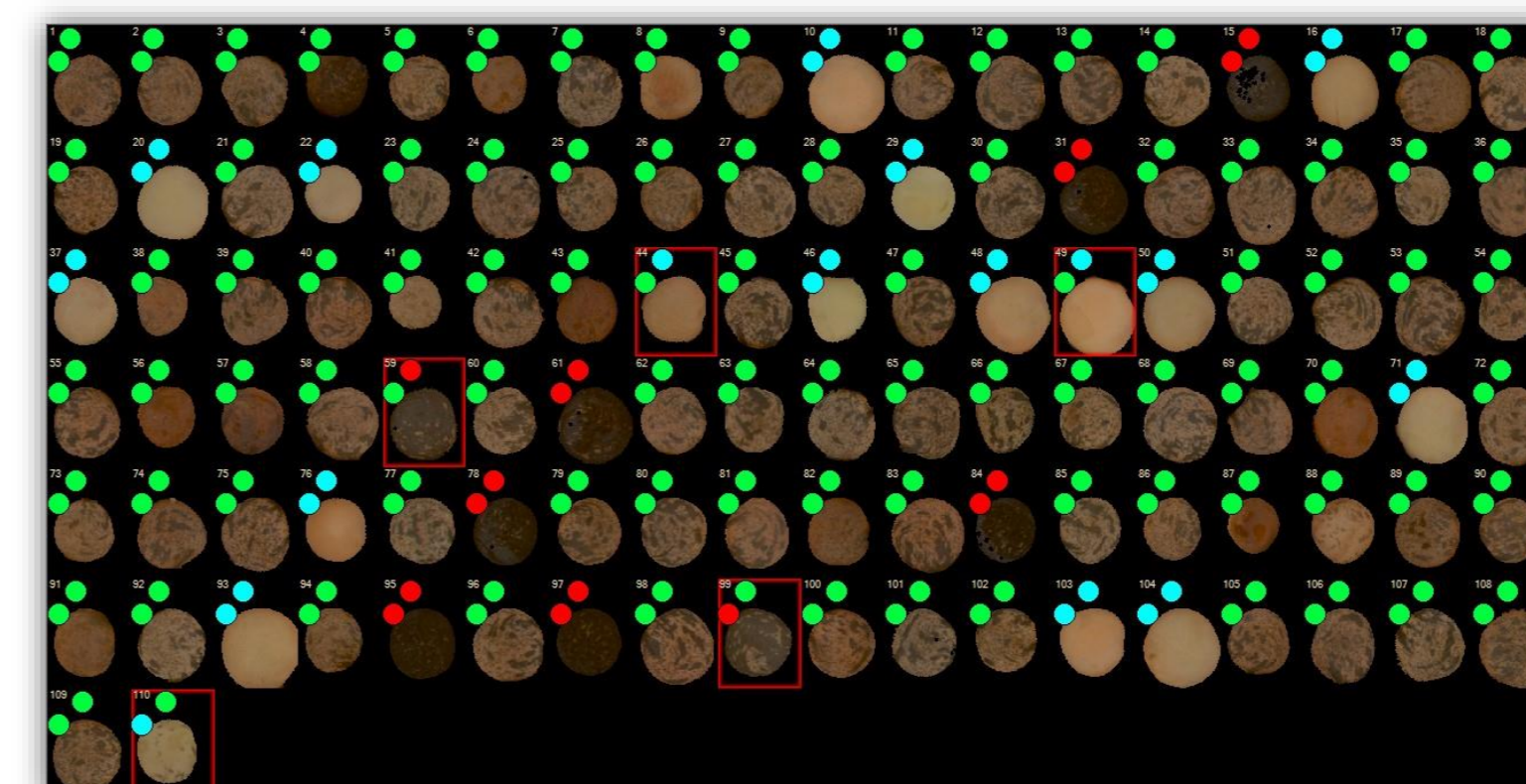**Figure 6:** Blob tool analysis of different ICARDA crops

The blob tool option in VideometerLab was able to predict the correct classes for the color of the lentil sample with **95%** precision.

Figure 7: Predicted classification of color and sorting by area through blob tool analysis
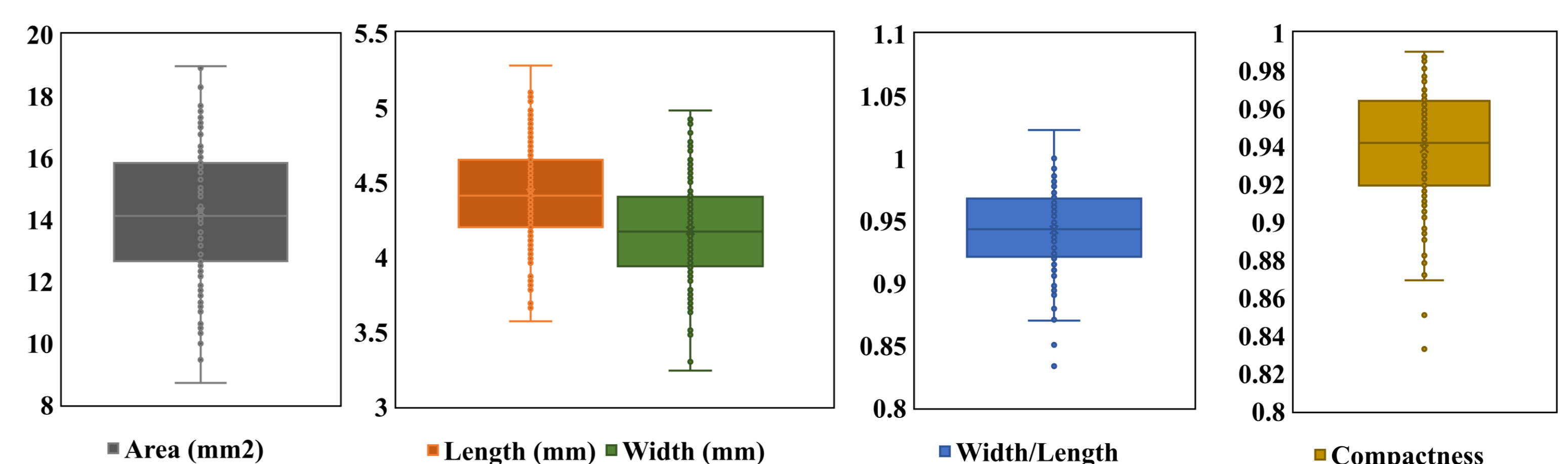

Figure 8: Box plot for different seed shape parameters of lentil
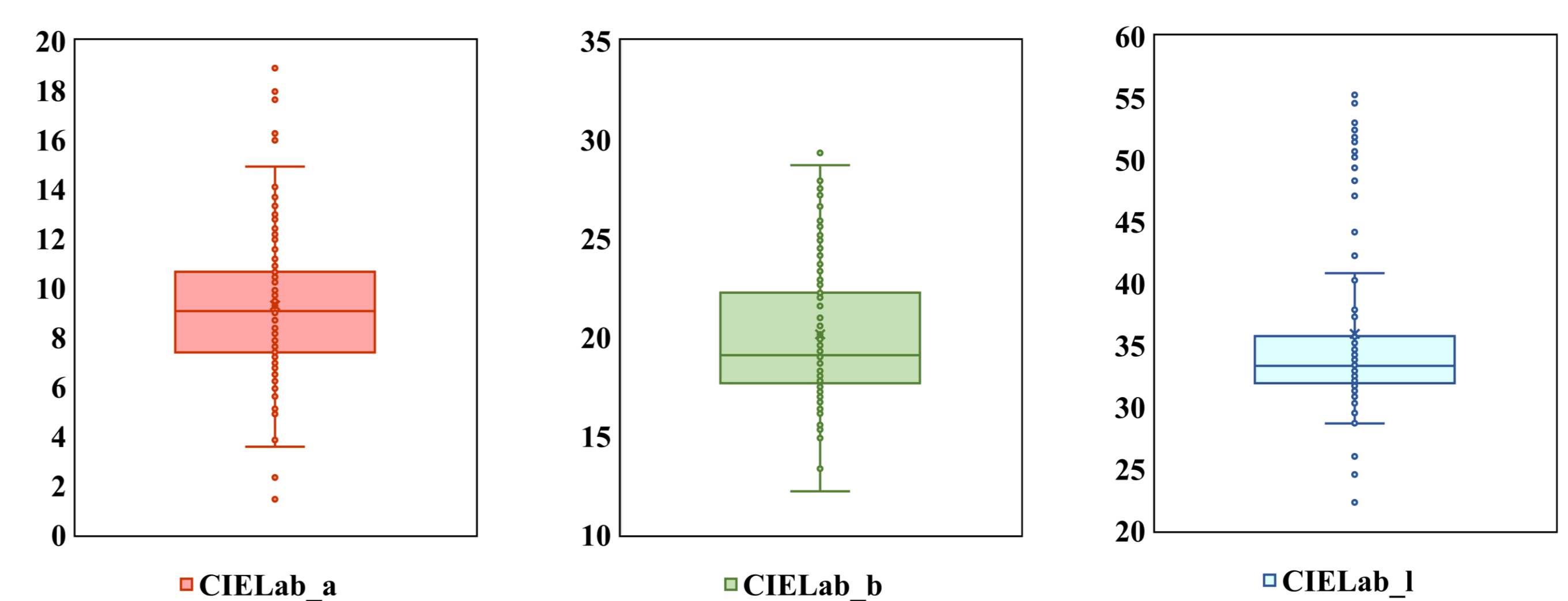

Figure 9: Box plot of different seed color parameters of lentil using CIELab scale
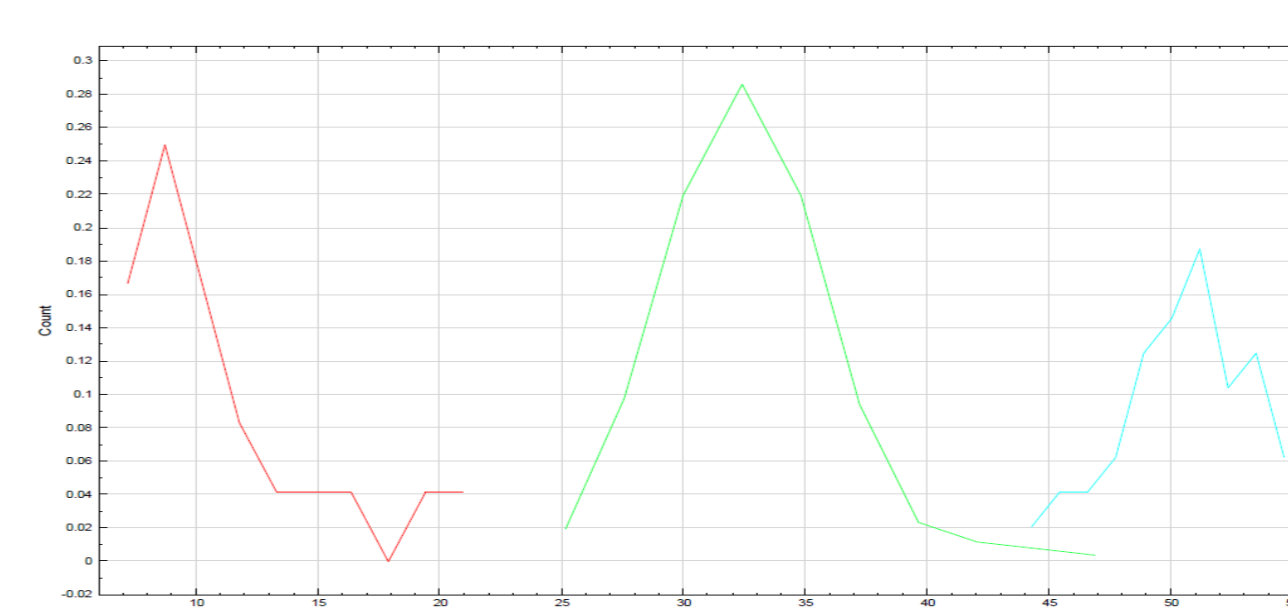

Figure 10: Histogram of seed coat parameters for lentil-VideometerLab

Conclusion

Merging the VideometerLab data with genetic information and establishing an online database will ensure a targeted selection for researchers and the use of ICARDA's germplasm to its optimum.