Gamma algorithms report

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2024

University of Costa Rica

2024-10-30

Executive Summary:

This report analyzes different algorithms focused on differentiating among Chrysina kalinini, C. resplendens and C. cupreomarginata species. These algorithms will analyze a particular spectrum and will produce a number. That index is going to be averaged and a boxplot will be made for each species. This information can be used in the future to analyze unknown spectra and make a guess of the most probable identity for a sample.

Specimen Information:

The following collections were used: ANGSOL CICIMAUCR1 CICIMAUCR2 CICIMAUCR3 INBUCR
Number of specimens per species:

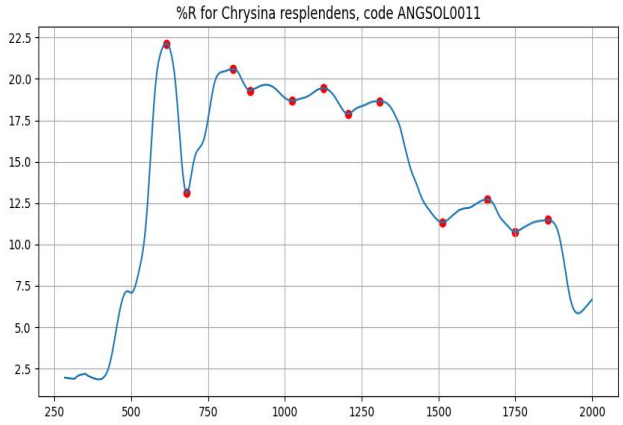
resplendens	kalinini	cupreomarginata
13	14	10

Relevant data:

code	genus	species	measuring_mode
ANGSOL0011	Chrysina	resplendens	%R
ANGSOL0012	Chrysina	kalinini	%R
ANGSOL0013	Chrysina	cupreomarginata	%R
ANGSOL0017	Chrysina	kalinini	%R
CICIMAUCR0104	Chrysina	resplendens	%R
CICIMAUCR0105	Chrysina	kalinini	%R
CICIMAUCR0158	Chrysina	cupreomarginata	%R
CICIMAUCR0001	Chrysina	kalinini	%R
CICIMAUCR0002	Chrysina	kalinini	%R
CICIMAUCR0003	Chrysina	kalinini	%R
CICIMAUCR0004	Chrysina	kalinini	%R
CICIMAUCR0006	Chrysina	kalinini	%R
CICIMAUCR0008	Chrysina	kalinini	%R
CICIMAUCR0009	Chrysina	kalinini	%R
CICIMAUCR0012	Chrysina	cupreomarginata	%R
CICIMAUCR0013	Chrysina	resplendens	%R

CICIMAUCR0014	Chrysina	cupreomarginata	%R
CICIMAUCR0015	Chrysina	resplendens	%R
CICIMAUCR0018	Chrysina	cupreomarginata	%R
CICIMAUCR0019	Chrysina	cupreomarginata	%R
CICIMAUCR0020	Chrysina	resplendens	%R
CICIMAUCR0021	Chrysina	resplendens	%R
CICIMAUCR0070	Chrysina	resplendens	%R
CICIMAUCR0071	Chrysina	resplendens	%R
CICIMAUCR0097	Chrysina	kalinini	%R
CICIMAUCR0098	Chrysina	cupreomarginata	%R
CICIMAUCR0100	Chrysina	cupreomarginata	%R
CICIMAUCR0101	Chrysina	resplendens	%R
CICIMAUCR0104	Chrysina	resplendens	%R
CICIMAUCR0108	Chrysina	resplendens	%R
CICIMAUCR0112	Chrysina	resplendens	%R
CICIMAUCR0113	Chrysina	kalinini	%R
CICIMAUCR0116	Chrysina	kalinini	%R
CICIMAUCR0141	Chrysina	kalinini	%R
CICIMAUCR0158	Chrysina	cupreomarginata	%R
INBUCR0426	Chrysina	resplendens	%R
INBUCR0433	Chrysina	cupreomarginata	%R

Spectral information :



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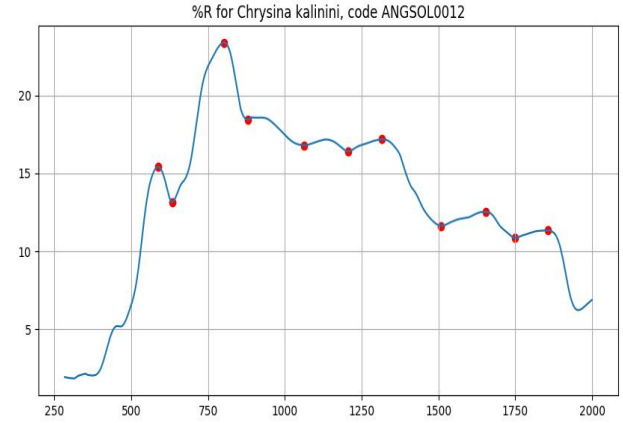

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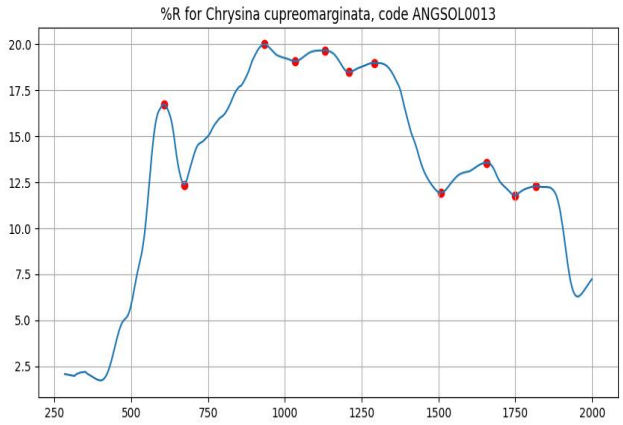

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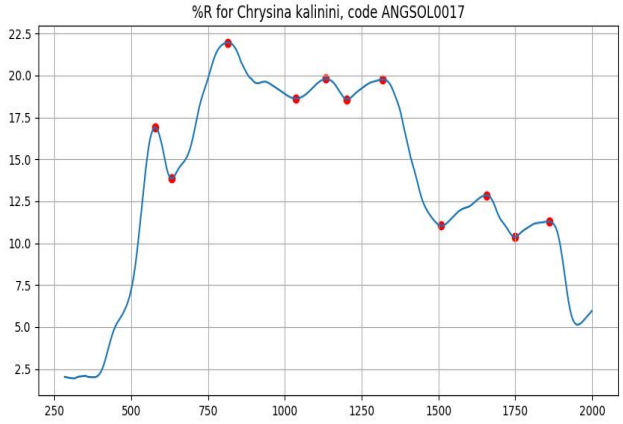

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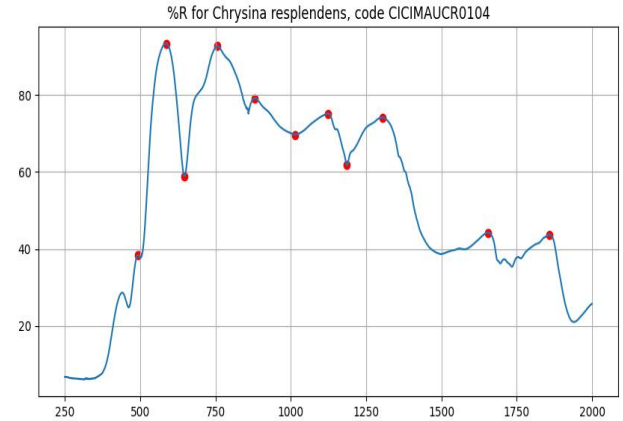

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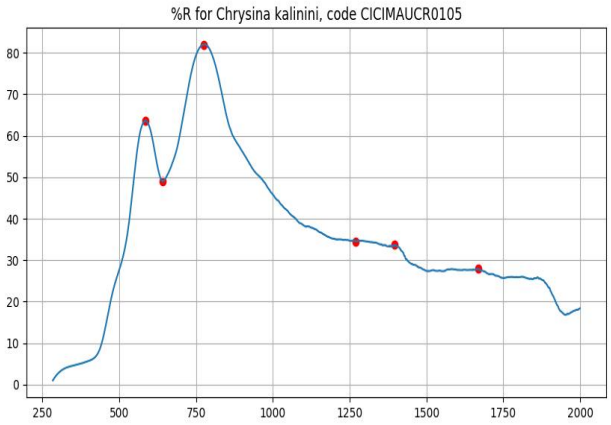

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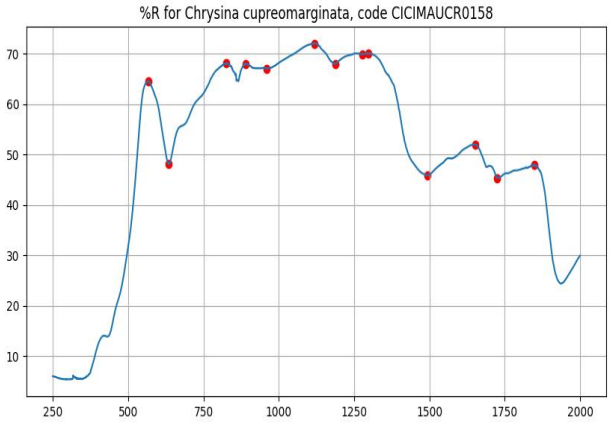

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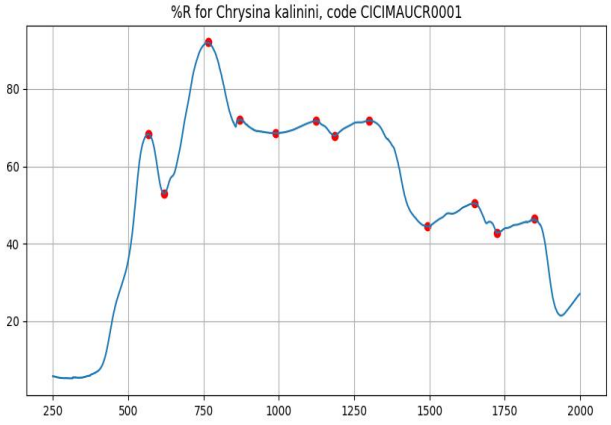

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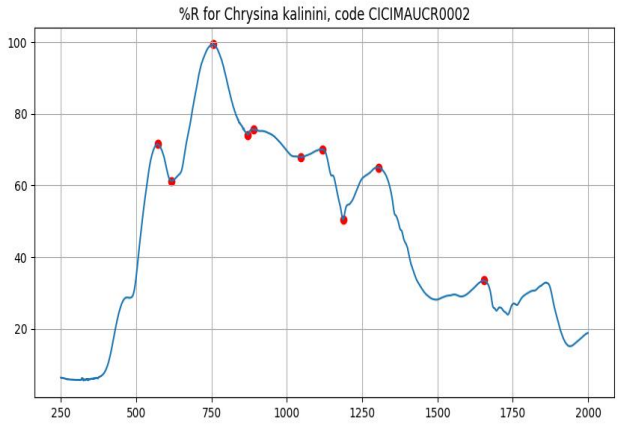

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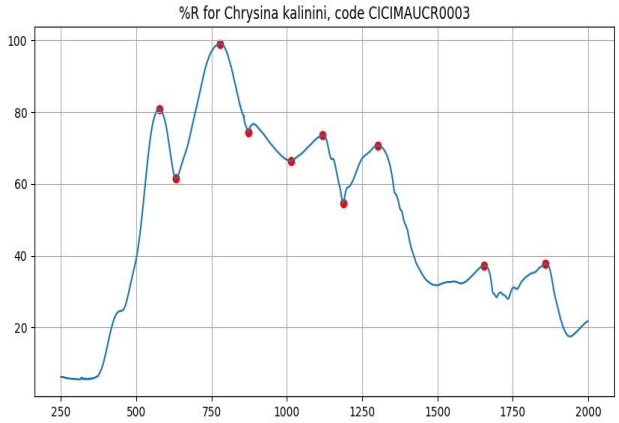

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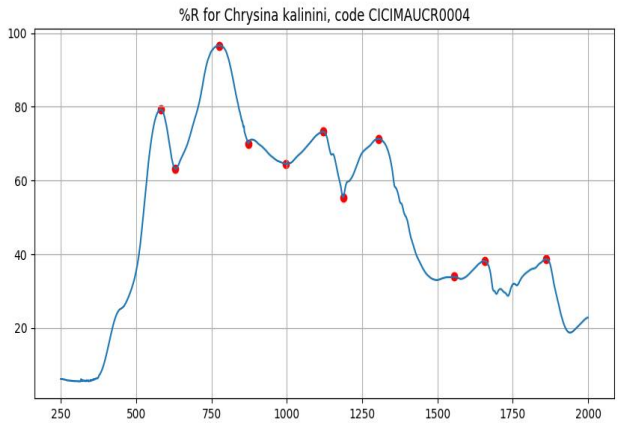

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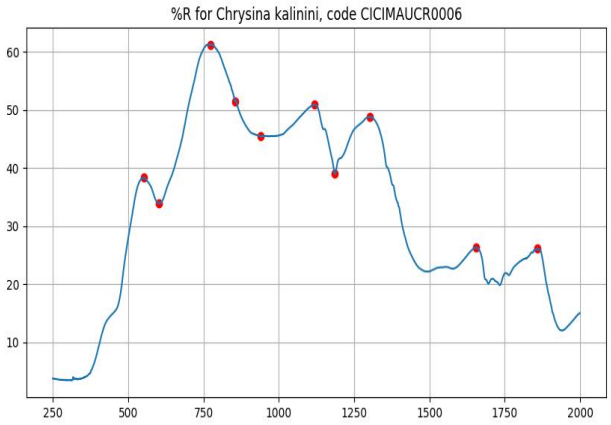
33.91538, 38.233073, 38.740653])



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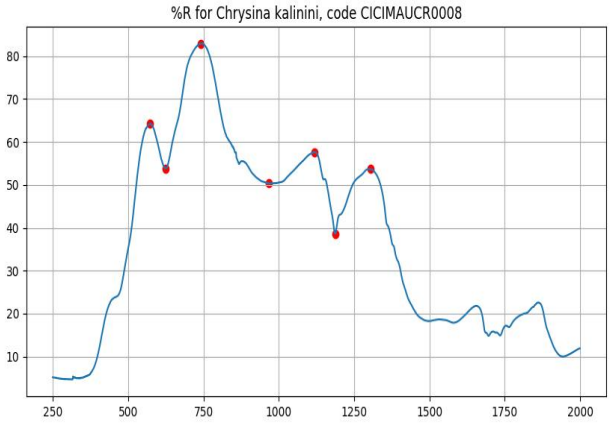

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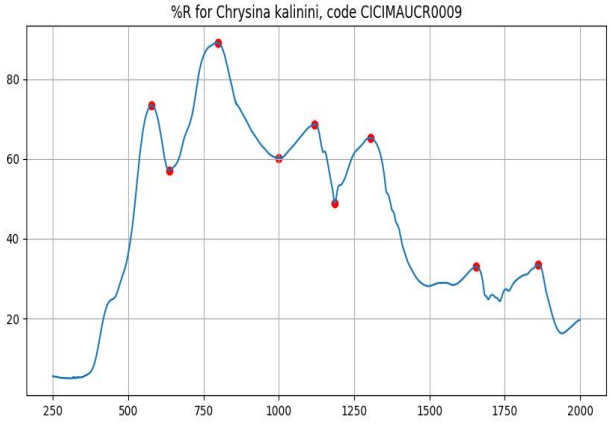

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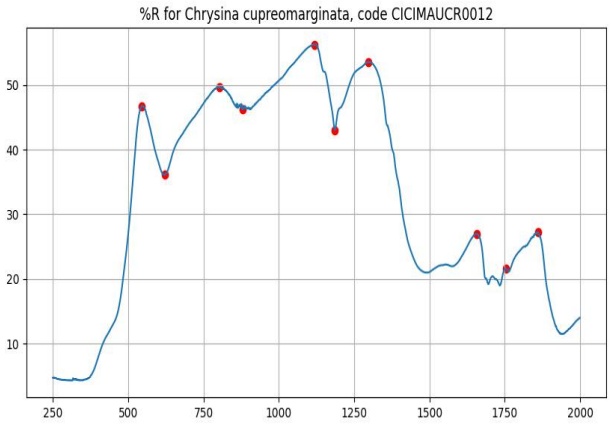

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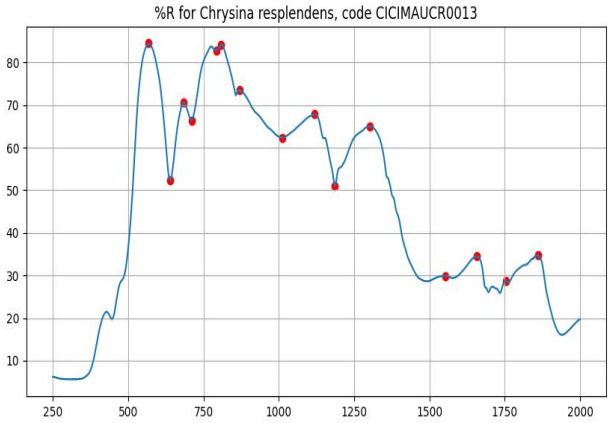

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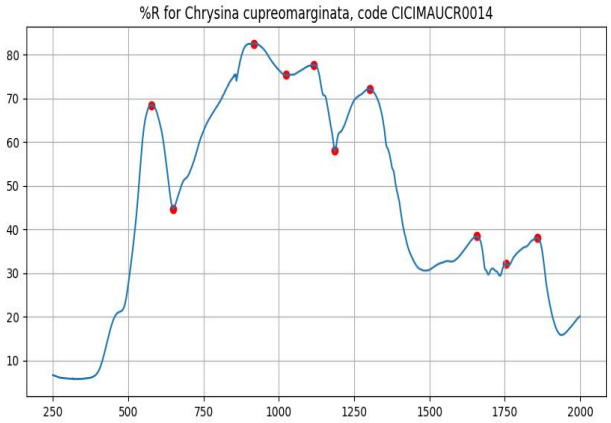

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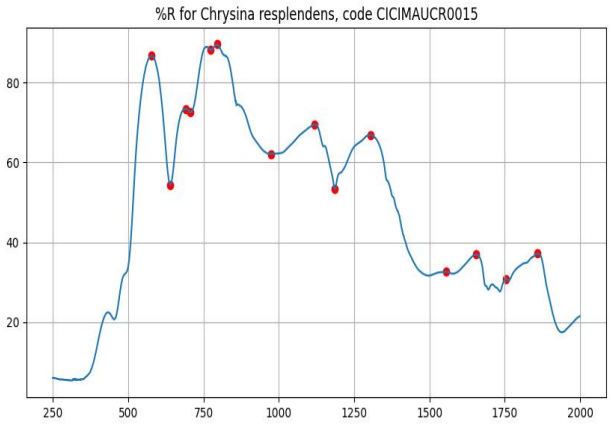
38.10403])



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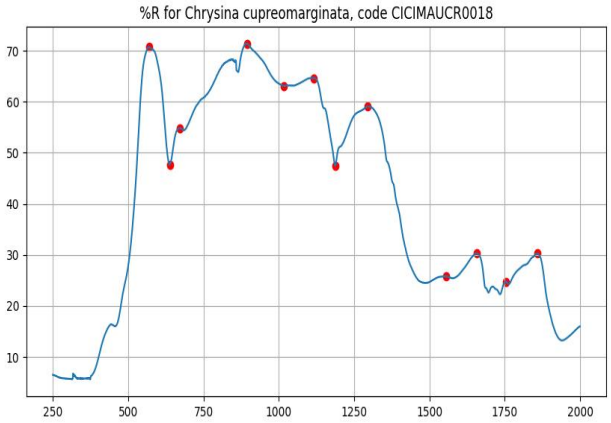

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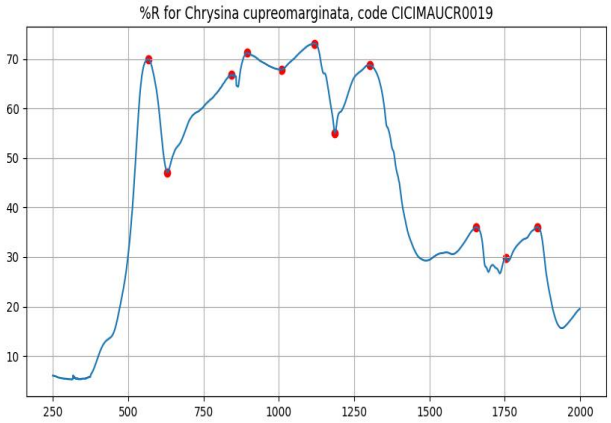

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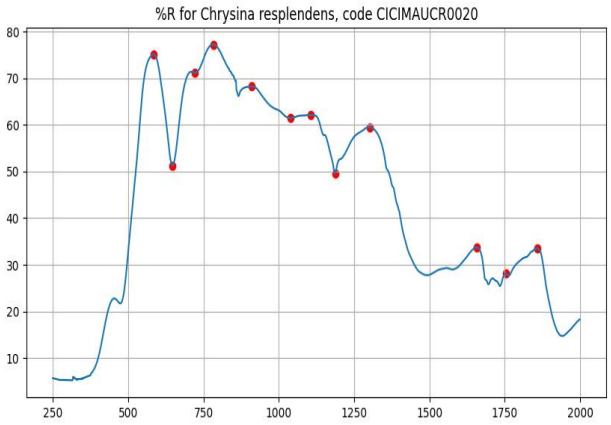
29.759332, 36.076873])



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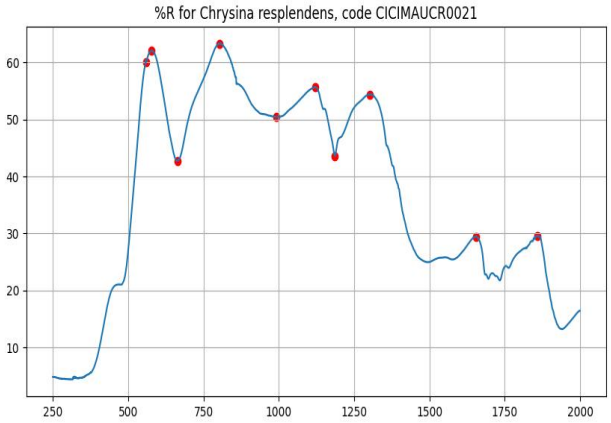

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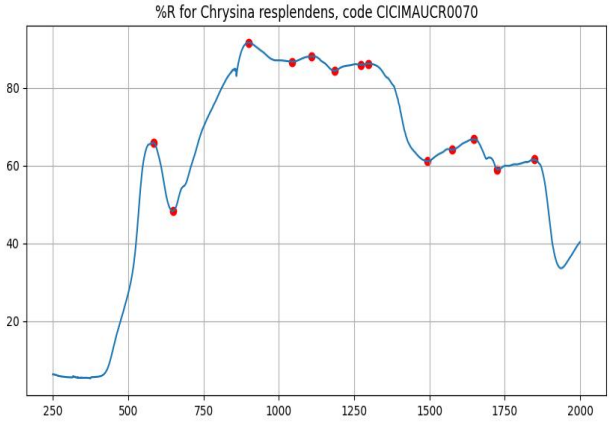

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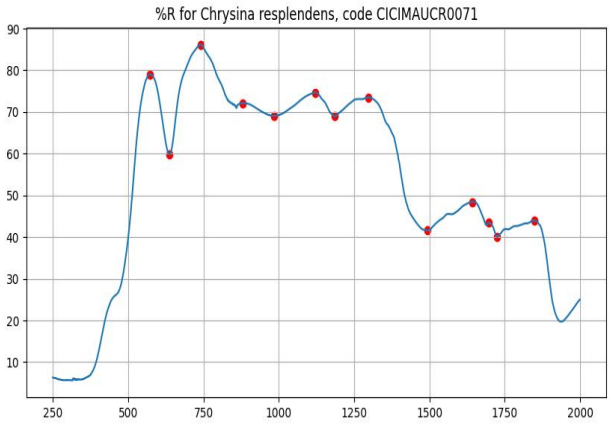

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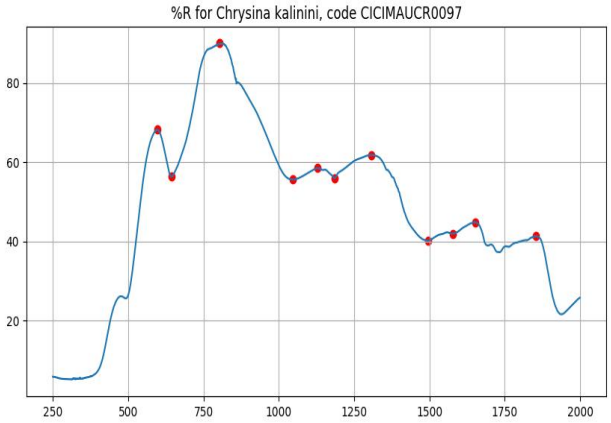

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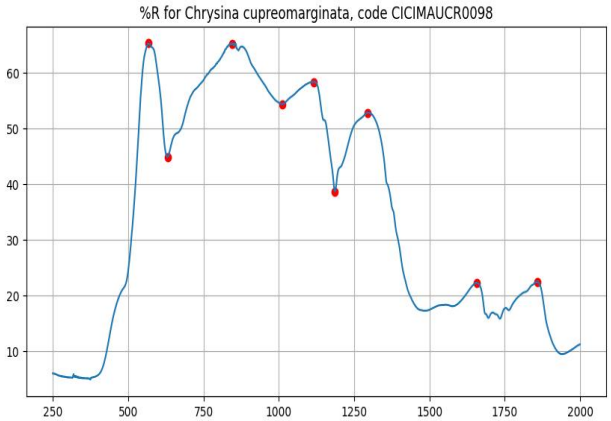

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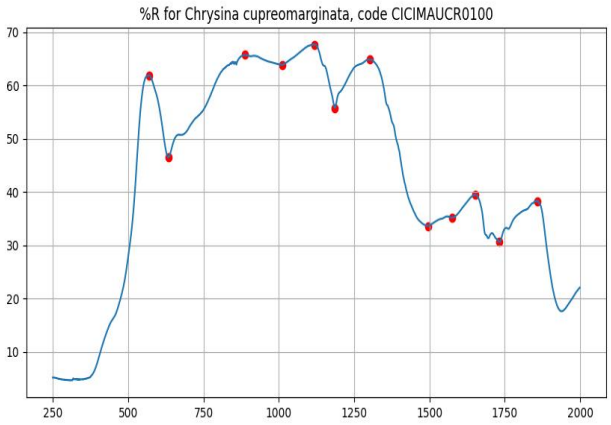

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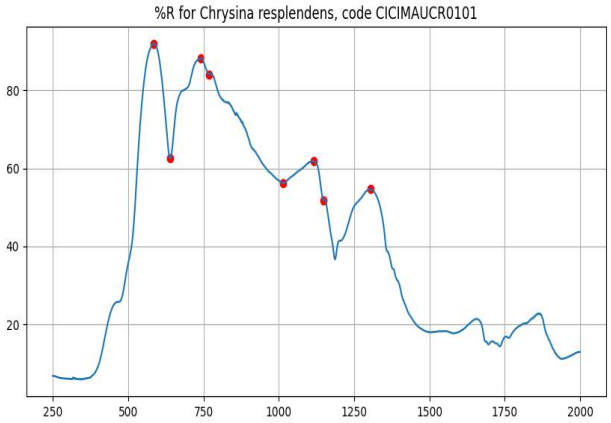

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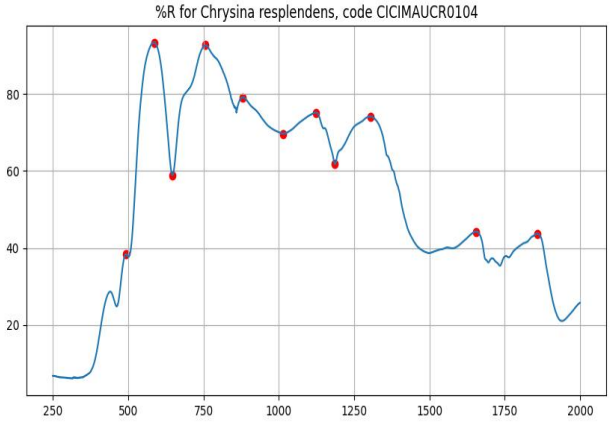
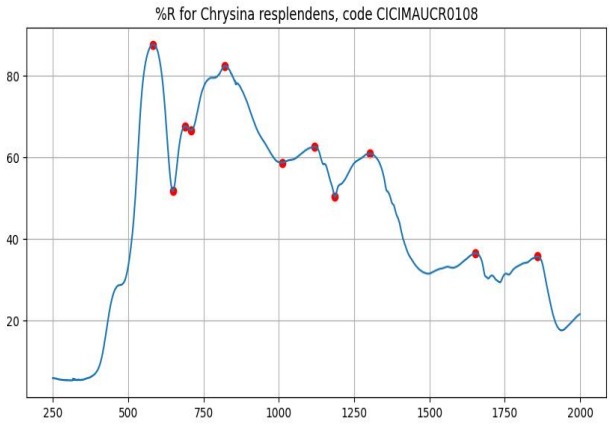
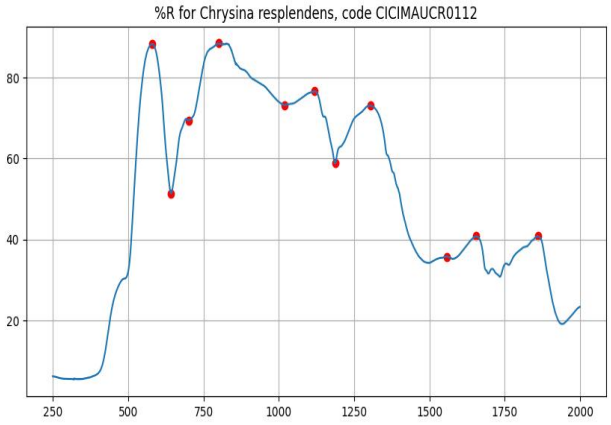


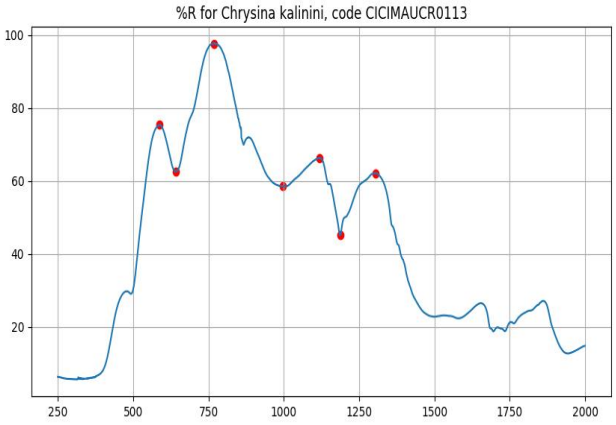
Peaks: ([493.0, 586.0, 647.0, 756.0, 881.0, 1014.0, 1123.0, 1186.0, 1305.0, 1654.0, 1857.0], [38.340033, 93.416433, 58.897433, 92.672367, 79.160728, 69.688095, 75.196279, 61.807723, 74.145899, 44.225596, 43.713928])



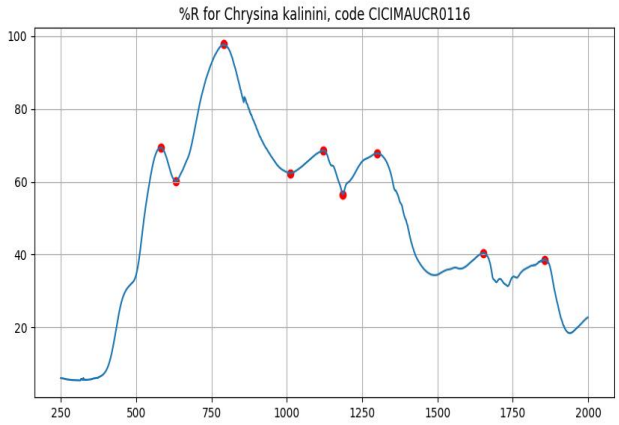
Peaks: ([582.0, 648.0, 690.0, 709.0, 820.0, 1011.0, 1119.0, 1186.0, 1302.0, 1653.0, 1857.0], [87.7686, 51.7798, 67.6363, 66.728067, 82.497833, 58.756218, 62.67716, 50.380652, 60.973791, 36.558641, 35.710999])



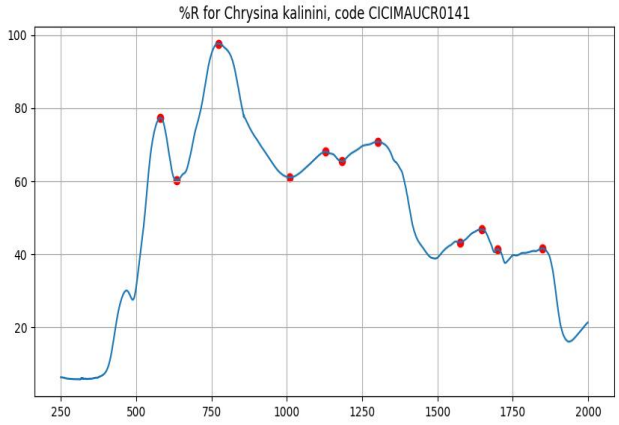
Peaks: ([579.0, 642.0, 701.0, 800.0, 1020.0, 1119.0, 1187.0, 1304.0, 1557.0, 1655.0, 1860.0], [88.298667, 51.4011, 69.427133, 88.430967, 73.194263, 76.593451, 58.83029, 73.089797, 35.812557, 40.825311, 40.827906])



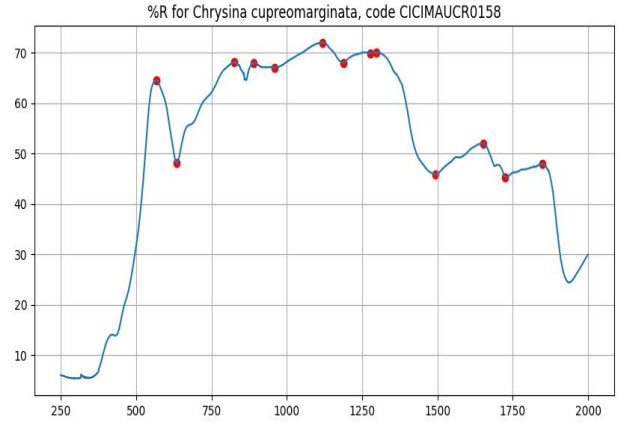
Peaks: ([587.0, 641.0, 769.0, 997.0, 1118.0, 1187.0, 1305.0], [75.351167, 62.559033, 97.681733, 58.46292, 66.267489, 45.044664, 62.115903])



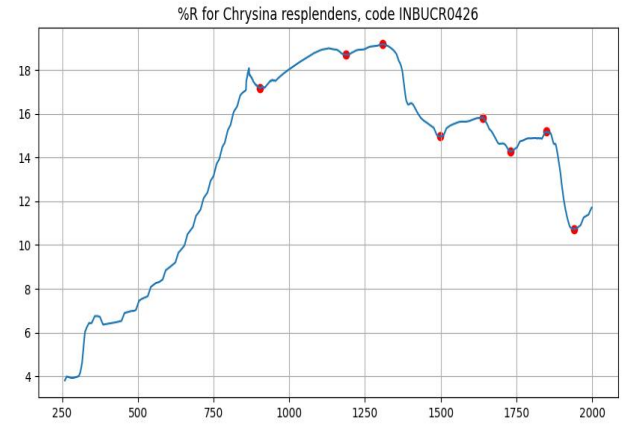
Peaks: ([581.0, 631.0, 790.0, 1012.0, 1122.0, 1186.0, 1299.0, 1653.0, 1856.0], [69.402067, 60.211933, 97.7267, 62.337684, 68.596212, 56.569552, 67.779008, 40.412513, 38.627693])



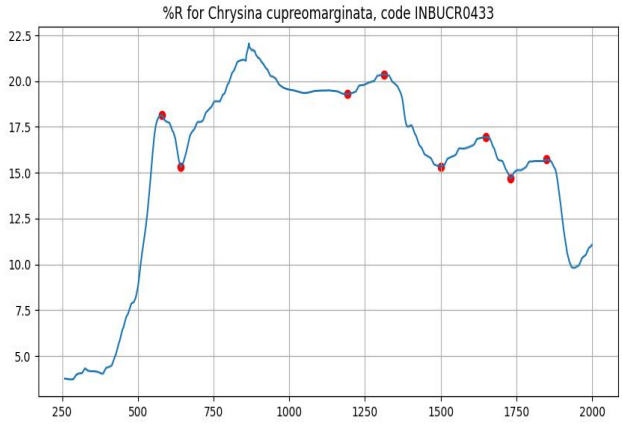
Peaks: ([580.0, 634.0, 773.0, 1009.0, 1129.0, 1184.0, 1302.0, 1574.0, 1647.0, 1698.0, 1849.0], [77.3671, 60.3228, 97.670367, 61.038037, 68.073968, 65.392446, 70.813184, 43.315609, 46.758232, 41.402103, 41.628476])



Peaks: ([566.0, 635.0, 825.0, 890.0, 960.0, 1119.0, 1187.0, 1276.0, 1296.0, 1493.0, 1651.0, 1725.0, 1848.0], [64.537975, 48.064025, 68.0696, 67.992822, 67.024724, 72.012286, 67.952517, 69.864476, 70.051844, 45.85374, 51.965073, 45.335223, 48.010766])



Peaks: ([904.0, 1188.0, 1309.0, 1499.0, 1640.0, 1730.0, 1850.0, 1941.0], [17.155883, 18.685173, 19.163968, 14.958598, 15.83011, 14.279285, 15.180038, 10.725523])



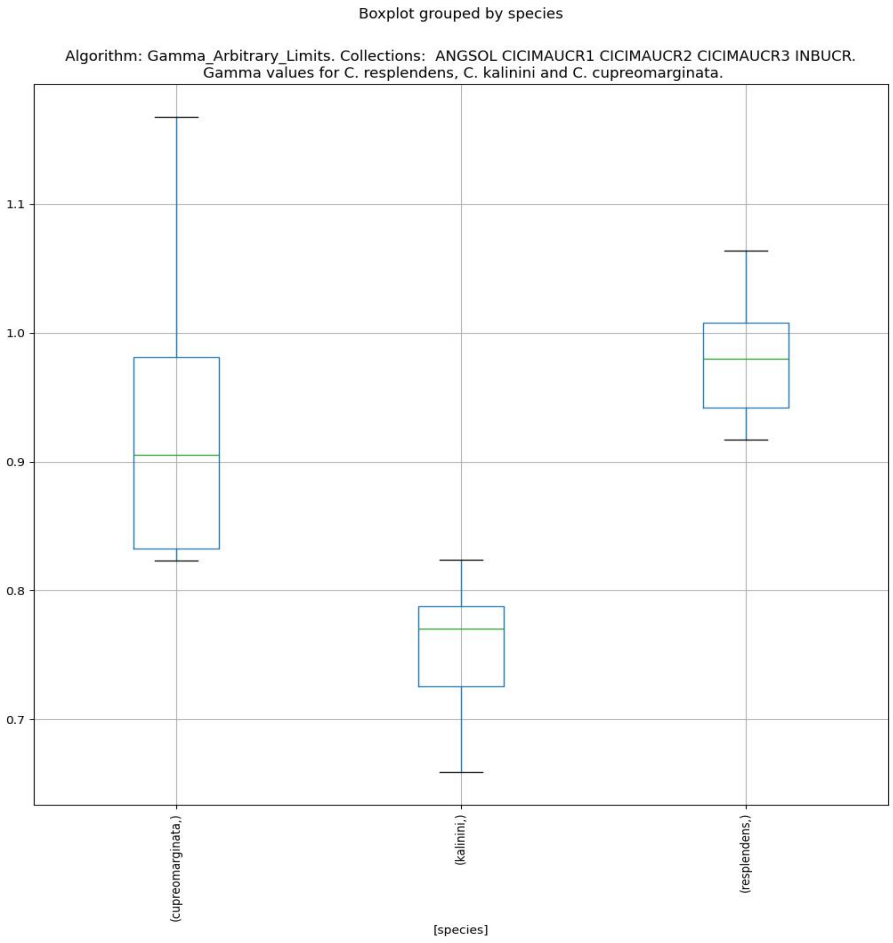
Peaks: ([579.0, 642.0, 1191.0, 1312.0, 1500.0, 1649.0, 1731.0, 1849.0], [18.157826, 15.316681, 19.288728, 20.363195, 15.34286, 16.939835, 14.70043, 15.719505])

Algorithm description: Gamma_Arbitrary_Limits

This algorithm calculates the ratio between the highest reflectance peak in the visible range (Between 400 nm and 625 nm) and the maximum peak in the IR range up to 1500 nm. Beyond 1500 nm the internal structure's reflectance generates unwanted noise.

Results

Gamma boxplot for Gamma_Arbitrary_Limits



Differentiable species:

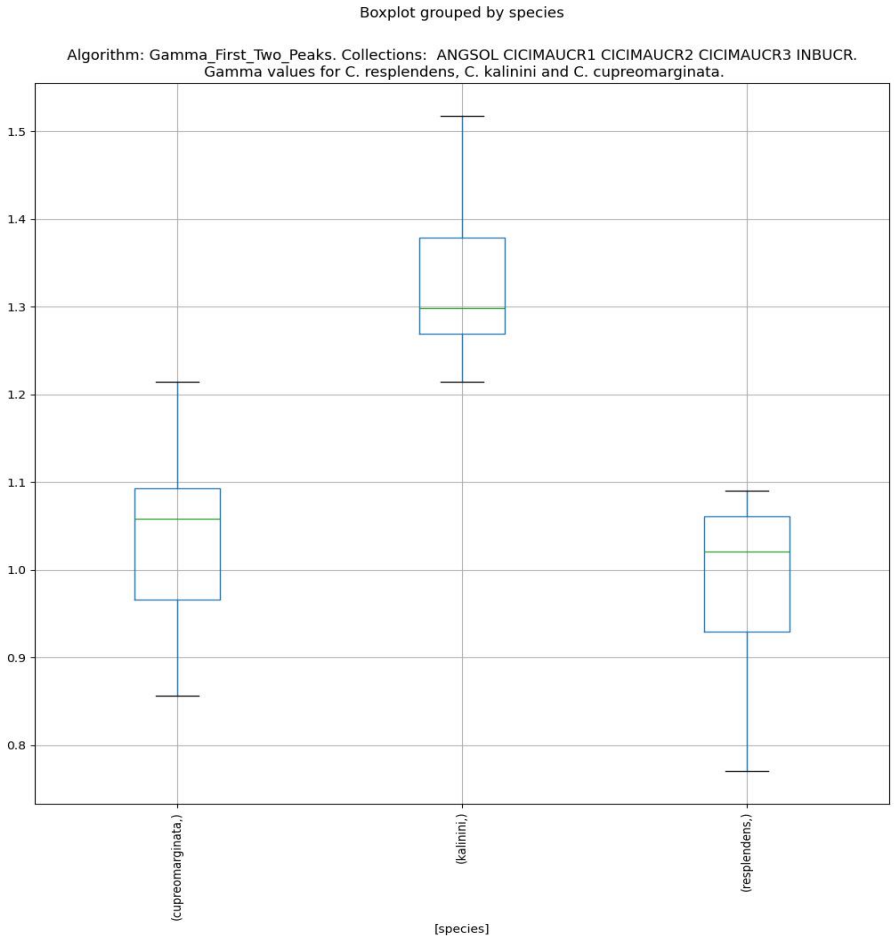
Assuming each species is distributed normally: Differentiable species are: ['kalinini']. 75.0% of these specimens will be found in a region in which the probability of being a specimen of other species is less than 25.0 %.

Algorithm description: Gamma_First_Two_Peaks

This algorithm calculates the ratio between the second and first reflectance peak.

Results

Gamma boxplot for Gamma_First_Two_Peaks



Differentiable species:

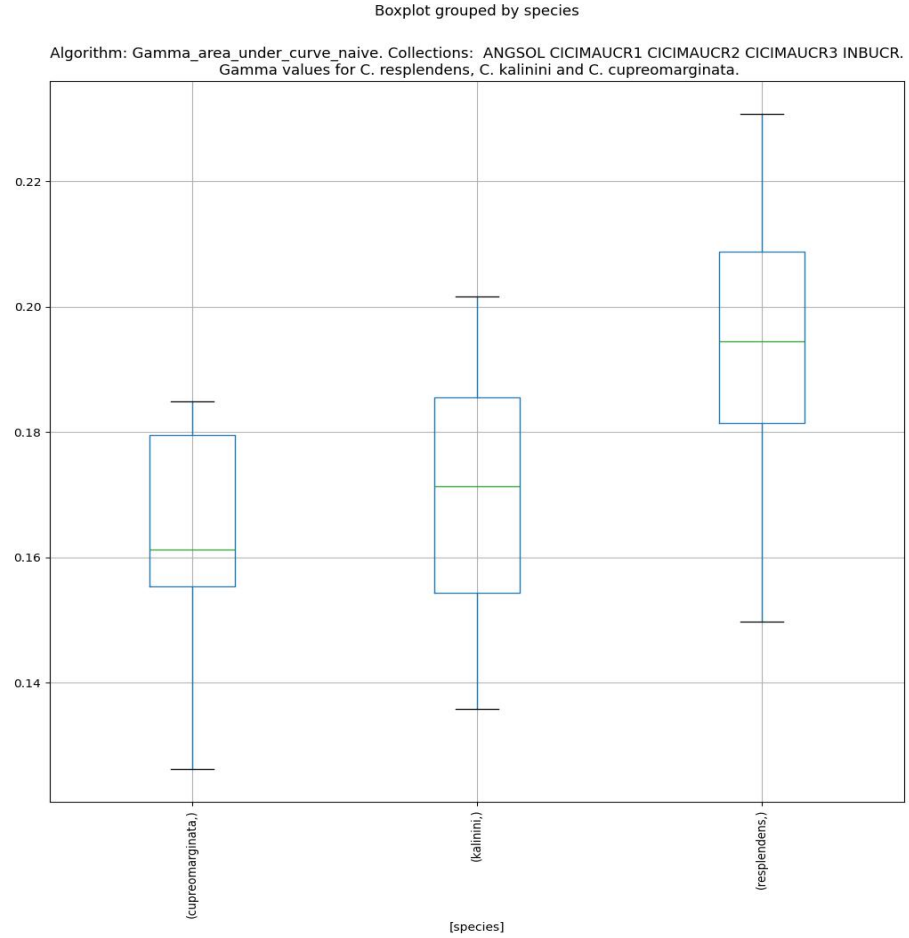
Assuming each species is distributed normally: Differentiable species are: ['kalinini']. 75.0% of these specimens will be found in a region in which the probability of being a specimen of other species is less than 25.0 %.

Algorithm description: Gamma_area_under_curve_naive

This method calculates the ratio between the area under the curve for the spectrum between 400 and 625 nm (visible range) and between 625 nm and 1500 nm (Infrarred range).

Results

Gamma boxplot for Gamma_area_under_curve_naive



No differentiable species could be found:

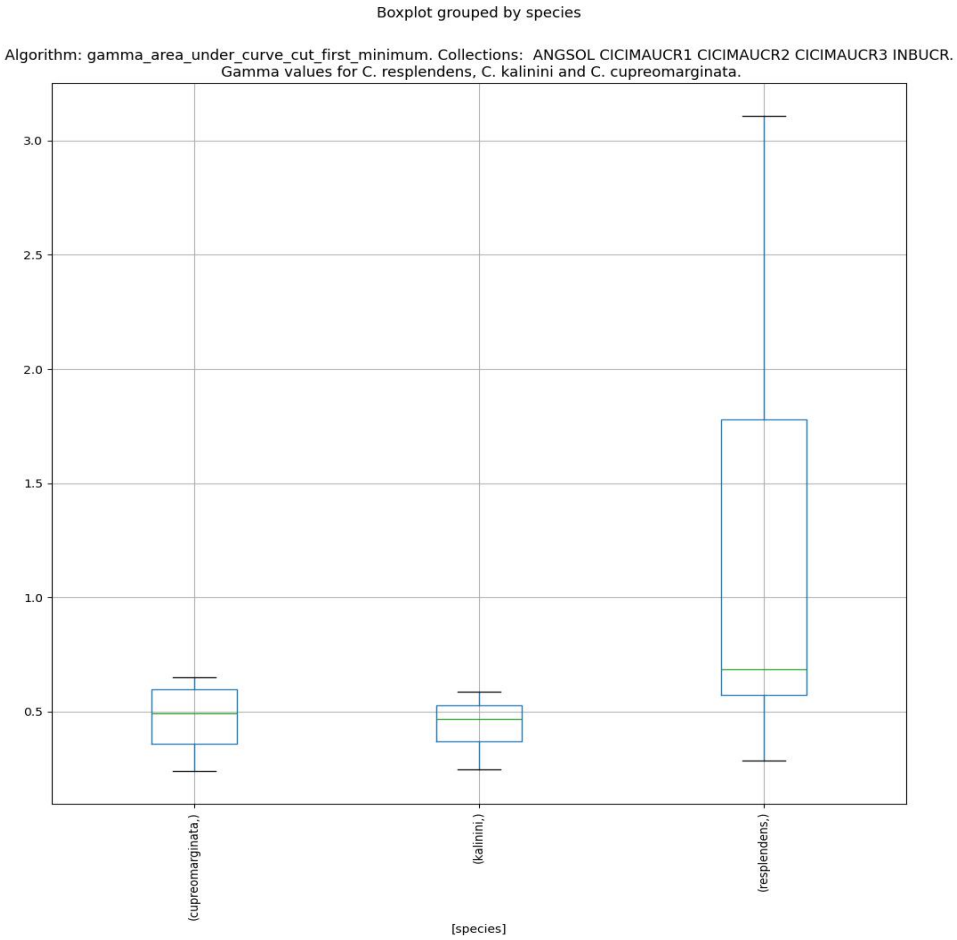
Assuming each species is distributed normally: There is no region in which 75.0% of the specimens of any species would not overlap with other's species central 75.0 percentile of individuals.

Algorithm description: gamma_area_under_curve_cut_first_minimum

This algorithm calculates the area for the visible region (starting at 450 and ending in the first minima between the maximum in the visible range and the maximum in the IR range. Then calculates the area of the IR range up to the second minumum. The ratio between these two areas is the gamma value.

Results

Gamma boxplot for gamma_area_under_curve_cut_first_minimum



No differentiable species could be found:

Assuming each species is distributed normally: There is no region in which 75.0% of the specimens of any species would not overlap with other's species central 75.0 percentile of individuals.

Similarity Index:

For each spectrum a similarity index is calculated which is the sum of the squared differences between the wavelength peak values of the unknown sample and the average wavelength peak values for each species.

Test results:

The reported(correct) species is compared with the species with the lowest similarity index (si), the final column (test_result) shows if the species coincide:

The amount of correct guesses is 14 out of 37

The accuracy (Percentage of correct classifications out of total classifications) is 37.84 %

For kalinini, precision (correct classifications out of all classifications for this species) is 37.84 % and recall (out of the actual specimens for this species how many were correctly classified) is 100.00 %.
For resplendens, precision is nan % and recall is 0.00 %.
For cupreomarginata, precision is nan % and recall is 0.00 %.

code	species	kali_si	cupr_si	resp_si	prediction
ANGSOL0011	resplendens	149.297	175.457	161.322	kalinini
ANGSOL0012	kalinini	145.241	171.402	160.166	kalinini
ANGSOL0013	cupreomarginata	148.978	175.139	161.003	kalinini
ANGSOL0017	kalinini	143.145	169.306	161.67	kalinini
CICIMAUCR0104	resplendens	133.006	159.167	148.331	kalinini
CICIMAUCR0105	kalinini	135.404	161.565	150.729	kalinini
CICIMAUCR0158	cupreomarginata	134.47	159.702	153.895	kalinini
CICIMAUCR0001	kalinini	134.16	159.392	153.585	kalinini
CICIMAUCR0002	kalinini	132.524	157.756	151.949	kalinini
CICIMAUCR0003	kalinini	129.939	156.1	149.264	kalinini
CICIMAUCR0004	kalinini	131.462	157.622	148.387	kalinini
CICIMAUCR0006	kalinini	143.157	168.389	162.582	kalinini
CICIMAUCR0008	kalinini	133.781	159.014	153.206	kalinini
CICIMAUCR0009	kalinini	131.638	157.799	150.563	kalinini
CICIMAUCR0012	cupreomarginata	142.672	167.904	162.097	kalinini
CICIMAUCR0013	resplendens	130.731	155.963	150.156	kalinini
CICIMAUCR0014	cupreomarginata	132.63	158.79	151.555	kalinini
CICIMAUCR0015	resplendens	129.185	155.346	147.71	kalinini

CICIMAUCR0018	cupreomarginata	133.291	158.523	152.716	kalinini
CICIMAUCR0019	cupreomarginata	134.036	159.268	153.461	kalinini
CICIMAUCR0020	resplendens	132.907	159.068	148.632	kalinini
CICIMAUCR0021	resplendens	137.203	162.436	156.628	kalinini
CICIMAUCR0070	resplendens	134.551	160.712	150.676	kalinini
CICIMAUCR0071	resplendens	131.011	156.243	150.436	kalinini
CICIMAUCR0097	kalinini	136.485	162.645	148.51	kalinini
CICIMAUCR0098	cupreomarginata	134.573	159.805	153.998	kalinini
CICIMAUCR0100	cupreomarginata	134.837	160.07	154.262	kalinini
CICIMAUCR0101	resplendens	129.519	155.679	145.244	kalinini
CICIMAUCR0104	resplendens	154.957	180.189	174.382	kalinini
CICIMAUCR0108	resplendens	129.771	155.932	146.696	kalinini
CICIMAUCR0112	resplendens	129.065	155.226	147.19	kalinini
CICIMAUCR0113	kalinini	133.255	159.415	148.18	kalinini
CICIMAUCR0116	kalinini	133.245	159.405	150.57	kalinini
CICIMAUCR0141	kalinini	131.452	157.612	149.177	kalinini
CICIMAUCR0158	cupreomarginata	135.117	160.35	154.542	kalinini
INBUCR0426	resplendens	208.294	234.455	220.319	kalinini
INBUCR0433	cupreomarginata	143.093	169.254	161.218	kalinini

Peak_Ratio_And_Wavelength_Similarity_Index:

This algorithm calculates the square difference for wavelength and the square difference in gamma values and multiplies them. Lower values are for spectra that has similar wavelengths and similar gamma values with respect to known spectra

Test results:

The reported(correct) species is compared with the species with the lowest similarity index (si), the final column (test_result) shows if the species coincide:

The amount of correct guesses is 22 out of 37

The accuracy (Percentage of correct classifications out of total classifications) is 59.46 %

For kalinini, precision (correct classifications out of all classifications for this species) is 82.35 % and recall (out of the actual specimens for this species how many were correctly classified) is 100.00 %.
For resplendens, precision is 33.33 % and recall is 7.69 %.
For cupreomarginata, precision is 41.18 % and recall is 70.00 %.

code	species	cupreomarginata	kalinini	resplendens	prediction
ANGSOL0011	resplendens	1.647	18.312	4.735	cupreomarginata
ANGSOL0012	kalinini	39.989	3.661	23.946	kalinini
ANGSOL0013	cupreomarginata	4.76	2.163	1.044	resplendens
ANGSOL0017	kalinini	12.223	0.123	5.263	kalinini
CICIMAUCR0104	resplendens	0.173	7.426	0.32	cupreomarginata
CICIMAUCR0105	kalinini	10.756	0.203	4.364	kalinini
CICIMAUCR0158	cupreomarginata	4.574	23.019	8.935	cupreomarginata
CICIMAUCR0001	kalinini	15.799	0.017	7.764	kalinini
CICIMAUCR0002	kalinini	20.069	0.304	10.678	kalinini
CICIMAUCR0003	kalinini	5.91	1.158	1.777	kalinini
CICIMAUCR0004	kalinini	5.579	1.316	1.572	kalinini
CICIMAUCR0006	kalinini	53.272	7.474	34.868	kalinini
CICIMAUCR0008	kalinini	10.789	0.179	4.56	kalinini
CICIMAUCR0009	kalinini	5.328	1.421	1.467	kalinini
CICIMAUCR0012	cupreomarginata	0.205	7.848	0.321	cupreomarginata
CICIMAUCR0013	resplendens	5.554	24.265	10.126	cupreomarginata
CICIMAUCR0014	cupreomarginata	0.861	5.336	0.008	resplendens
CICIMAUCR0015	resplendens	4.965	23.018	9.242	cupreomarginata
CICIMAUCR0018	cupreomarginata	9.785	31.129	15.363	cupreomarginata

CICIMAUCR0019	cupreomarginata	0.823	14.444	3.328	cupreomarginata
CICIMAUCR0020	resplendens	0.0	9.303	0.891	cupreomarginata
CICIMAUCR0021	resplendens	0.008	10.103	1.128	cupreomarginata
CICIMAUCR0070	resplendens	20.612	0.325	10.701	kalinini
CICIMAUCR0071	resplendens	0.592	5.842	0.054	resplendens
CICIMAUCR0097	kalinini	13.496	0.021	5.885	kalinini
CICIMAUCR0098	cupreomarginata	0.123	11.279	1.69	cupreomarginata
CICIMAUCR0100	cupreomarginata	0.174	7.525	0.332	cupreomarginata
CICIMAUCR0101	resplendens	0.724	13.684	3.0	cupreomarginata
CICIMAUCR0104	resplendens	347.85	141.128	276.329	kalinini
CICIMAUCR0108	resplendens	10.04	30.893	15.235	cupreomarginata
CICIMAUCR0112	resplendens	0.105	10.707	1.566	cupreomarginata
CICIMAUCR0113	kalinini	11.179	0.143	4.627	kalinini
CICIMAUCR0116	kalinini	22.423	0.546	12.04	kalinini
CICIMAUCR0141	kalinini	8.436	0.507	3.115	kalinini
CICIMAUCR0158	cupreomarginata	0.112	7.91	0.428	cupreomarginata
INBUCR0426	resplendens	0.238	11.722	0.496	cupreomarginata
INBUCR0433	cupreomarginata	5.755	1.528	1.59	kalinini

References

1. Author A, et al. (Year). Title of the paper. Journal Name, Volume(Issue), Page Numbers.
2. Author B, et al. (Year). Title of the paper. Journal Name, Volume(Issue), Page Numbers.