Mycotoxin levels in maize grown on different conservation soil tillage systems

Ivana Dodlek Šarkanj[1], Michael Sulyok[2], Boris Antunović[3], Irena Jug[3], Boris Đurđević[3], Bojana Brozović[3], Rudolf Krska[2], Bojan Šarkanj[1], and Danijel Jug[3]

[1]University North, Department of Food Technology, University Centre Koprivnica, Trg Žarka Dolinara 1, 48000 Koprivnica, Croatia

[2] University of Natural Resources and Life Sciences, Vienna (BOKU), Department IFA-Tulln, Konrad-Lorenz-Str. 20, 3430 Tulln, Austria

[3]Faculty of Agrobiotechnical Sciences Osijek, Josip Juraj Strossmayer University of Osijek, Vladimira Preloga 1, HR-31000, Osijek, Croatia

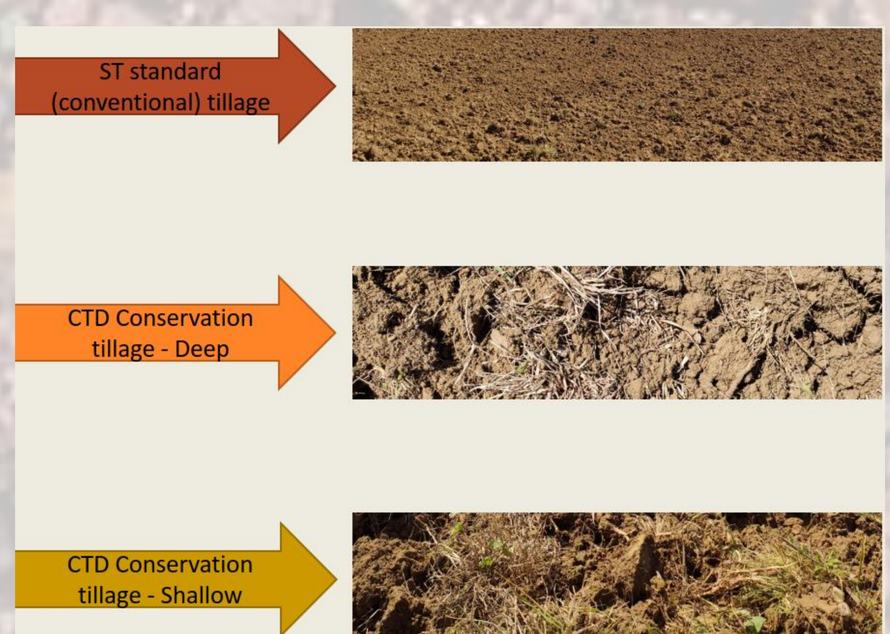
Introduction

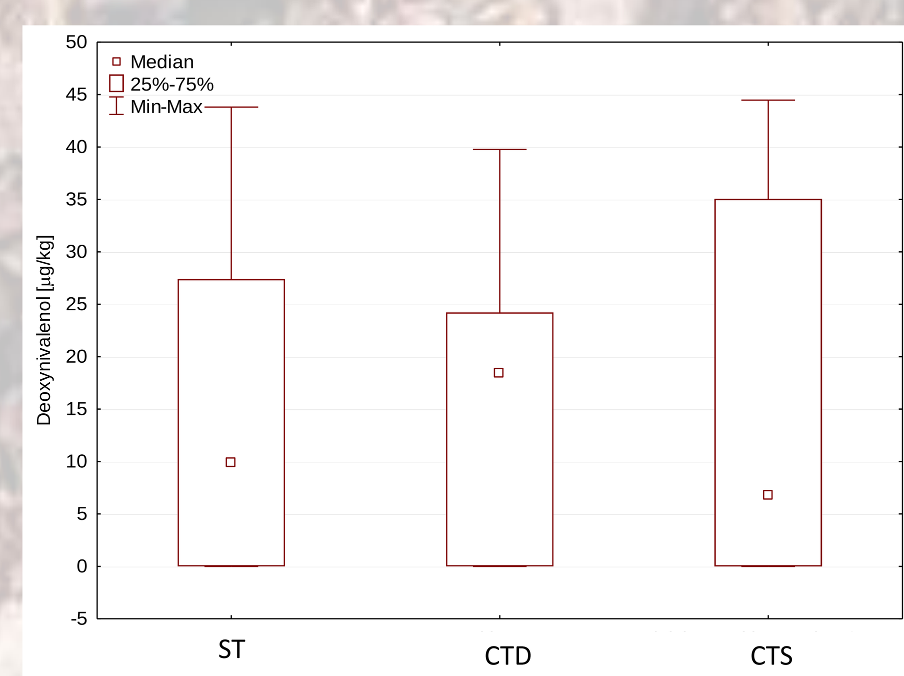
As Climate Change (CC) are recognised as one of the main threats for food and feed security and safety, each concerned and interested parties try to find "most elegant way-out" from that position. Also, in relation to CC, its expected impact on the presence of mycotoxins in food and feed is of great concern. One of the most adaptable and applicable platforms in combat to climate change on global level is Conservation Agriculture (CA). In 2021 was set up experiment on two different locations (eastern and western part of Croatia) with different conservation tillage treatments (as part of three main pillars of CA). One of the main goals of this project are try to find influence of different conservation soil tillage treatment (in comparison with conventional) on occurrence intensity of different type of mycotoxins (maize in 2021 year).

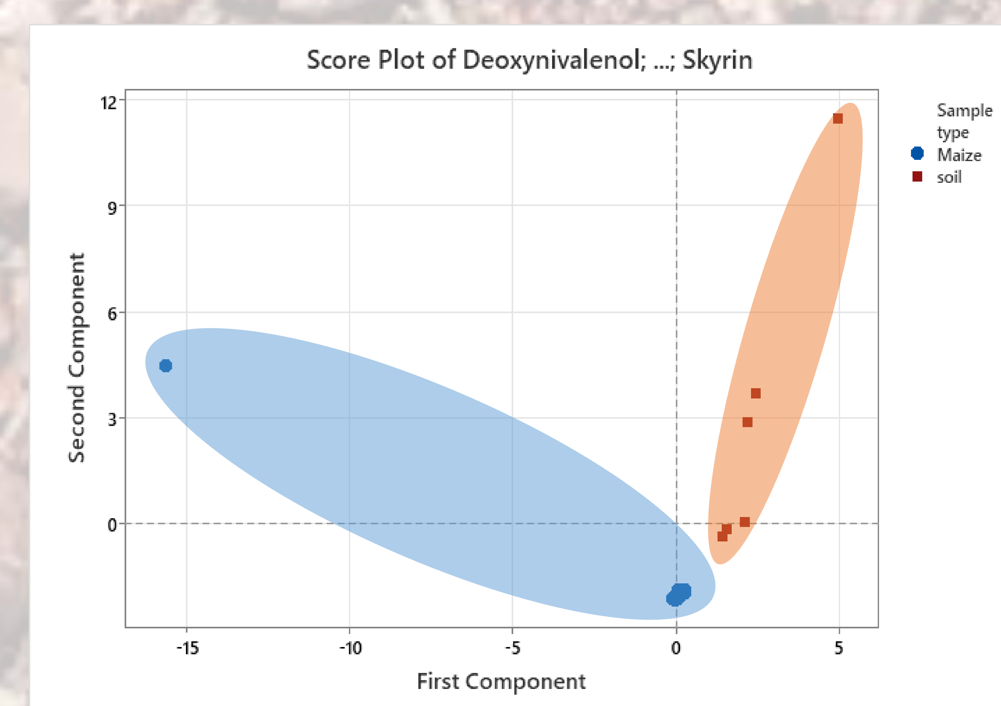
Results & discussion

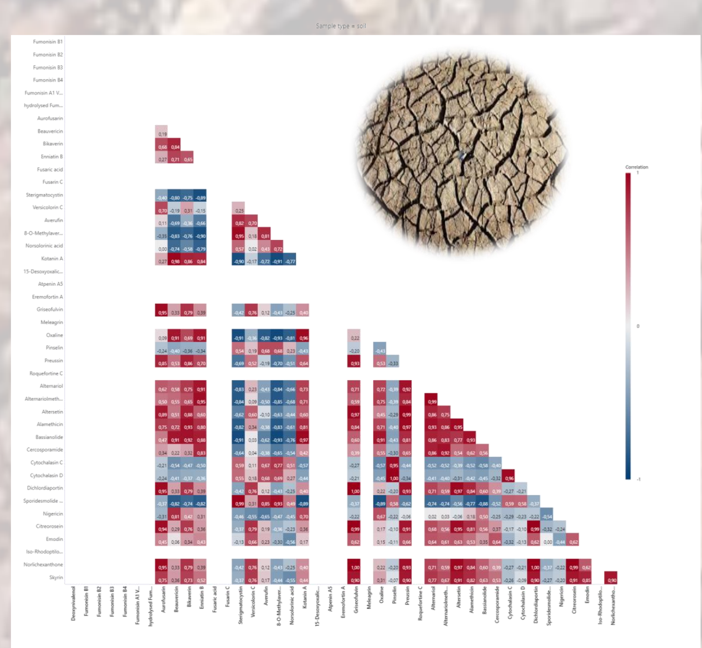
Soil and maize were analysed, and the mycotoxin profiles were obtained. As expected certain, regulated, mycotoxins were prevalent in maize, while emerging mycotoxins, *Aspergillus* and *Alternaria* metabolites had higher occurrence and concentrations in soil. The effect of the tillage treatment showed differences in the concentrations of mycotoxins in both soil and maize, where conservation soil tillage treatment showed reduced mycotoxins concentrations. Only one sample exceeded regulated concentrations of Fumonisins, while other samples had all mycotoxin levels within legal limits. Results showed that conventional tiling technique had highest result of mycotoxins in maize, and one sample exceeded the maximal levels of sum of Fumonisin in maize. The maize analysis showed higher prevalence and concentrations of Fusarium and *Pennicillium* mycotoxins, while soil showed exclusively presence of *Aspergillus* and *Alternaria* metabolites. Only three metabolites were occurring in both soil and maize: *Fusarium* metabolites: Enniatin B, Bikaverin and *Penicillium* metabolite Oxaline.

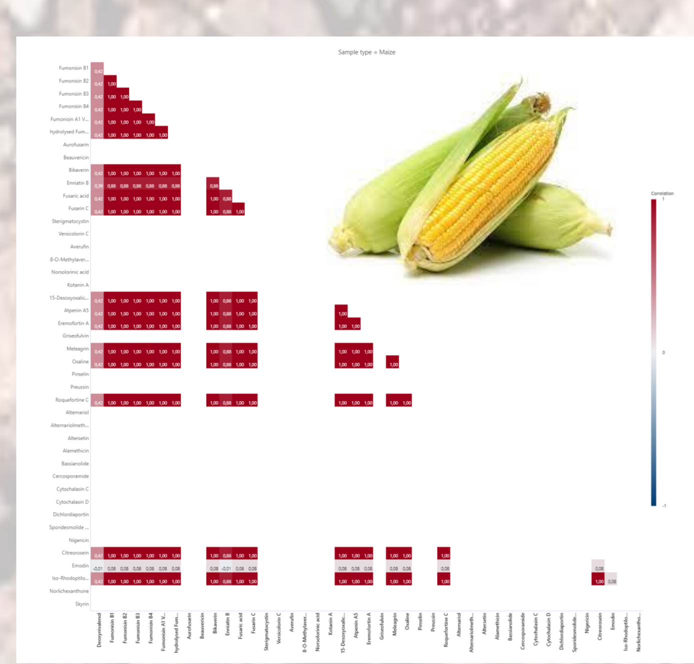
Statistical analysis showed that there was no statistically significant differences between two locations accept in Bikaverin and Oxaline (Mann – Whitney U test; p-value was less than 0,05). The Principal component analysis showed that based on first two components you could diferenciate between diferent sample types (soil and maize); different locations (Križevci and Čačinci), and between conventional and conservation technique, but not as easily between two different conservation techniques.

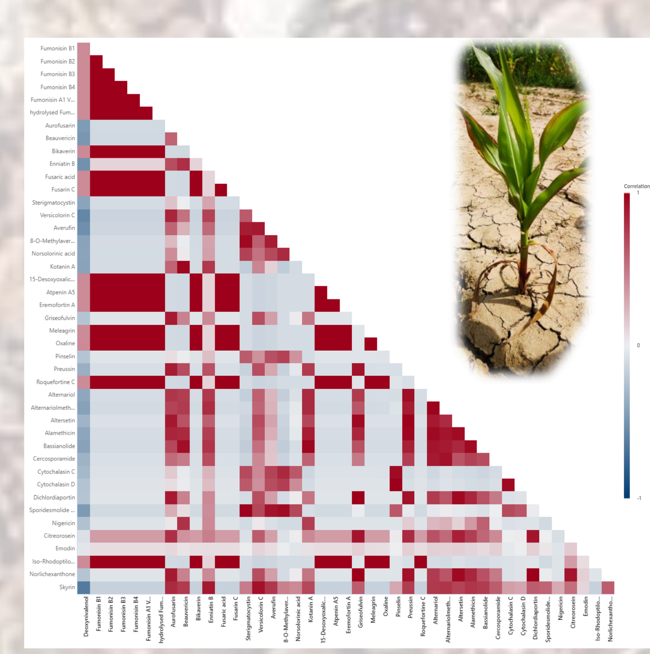


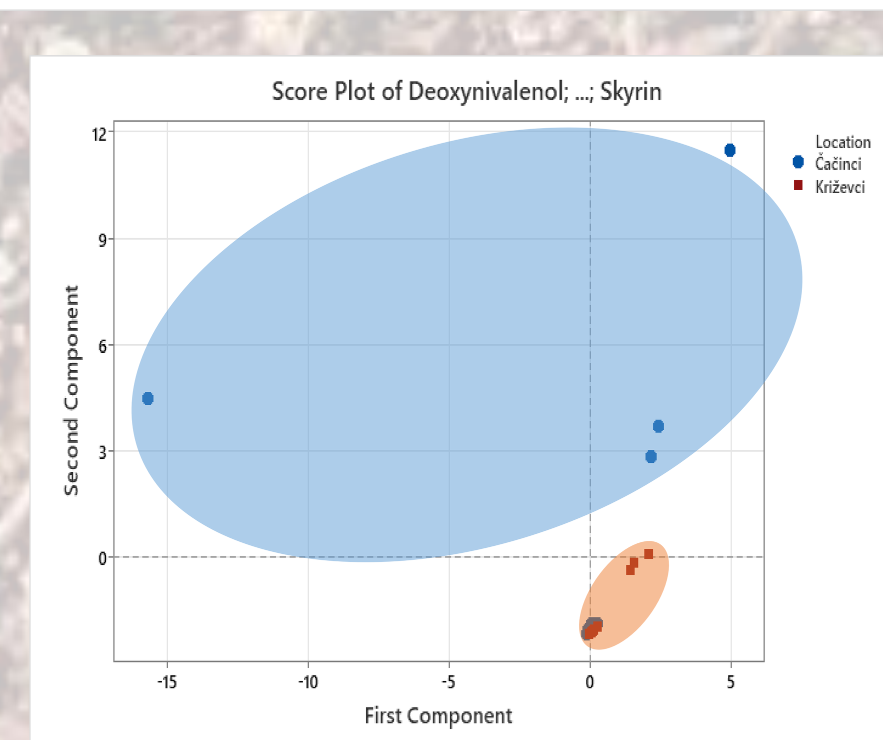












	Tillage	ST	ST	CTD	CTD	CTS	CTS	ST	ST	CTD	CTD	CTS	CTS	ST	CTD	CTS	ST	CTD	CTS
	Location	Čačinci	Čačinci	Čačinci	Čačinci	Čačinci	Čačinci	Križevci	Križevci	Križevci	Križevci	Križevci	Križevci	Čačinci	Čačinci	Čačinci	Križevci	Križevci	Križevci
	SampleType	Maize	Maize	Maize	Maize	Maize	Maize	Maize	Maize	Maize	Maize	Maize	Maize	Soil	Soil	Soil	Soil	Soil	Soil
Fusarium metabolites	Deoxynivalenol	19.75	43.81	24.22	39.77	< LOD	44.47	27.40	21.26	35.05	< LOD	15.59	13.65	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD
	Fumonisin B1	< LOD	7015.20	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD
	Fumonisin B2	< LOD	1247.20	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD
	Fumonisin B3	< LOD	611.36	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD
	Fumonisin B4	< LOD	412.11	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD
	Fumonisin A1 Vorstufe	< LOD	36.48	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD
	hydrolysed Fumonisin B1	< LOD	0.98	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD
	Aurofusarin	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	11.30	14.66	76.68	11.54	13.95	31.69
	Beauvericin	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	2.30	1.01	1.50	0.37	0.28	0.23
	Bikaverin*	< LOD	738.55	< LOD	6.67	< LOD	5.90	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	0.83	0.22	1.21	< LOD	< LOD	< LOD
	Enniatin B*	< LOD	0.14	< LOD	0.05	0.05	0.02	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	0.26	0.32	0.28	0.16	0.18	0.16
	Fusaric acid	< LOD	680.69	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD
	Fusarin C	< LOD	2221.60	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD
Penicillium metabolites	15-Desoxyoxalicine B	< LOD	127.04	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD
	Atpenin A5	< LOD	27.31	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD
	Eremofortin A	< LOD	7.66	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD
	Griseofulvin	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	0.28	< LOD	< LOD	< LOD
	Meleagrin	< LOD	7.92	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD
	Oxaline*	< LOD	130.20	< LOD	1.41	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	0.30	0.25	0.18	< LOD	< LOD	< LOD
	Pinselin	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	2.35	< LOD
	Preussin	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	2.03	3.46	9.72	< LOD	< LOD	< LOD
	Roquefortine C	< LOD	1.64	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD
Alternaria metabolites	Alternariol	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	0.13	0.30	0.39	< LOD	< LOD	< LOD
	Alternariolmethylether	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	0.83	2.05	1.99	0.07	0.12	0.12
	Altersetin	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	1.56	1.82	8.40	< LOD	< LOD	< LOD
Aspergillus metabolites	Sterigmatocystin	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	0.38	0.36	0.20
	Versicolorin C	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	0.17	0.22	0.83	0.57	0.54	0.31
	Averufin	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	0.05	0.12	0.48	0.63	0.82	0.37
	8-O-Methylaverufin	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	0.18	0.27	0.17
	Norsolorinic acid	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	0.30	0.75	1.20	2.34
	Kotanin A	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	1.05	0.60	0.79	< LOD	< LOD	< LOD

Materials & Methods

SAMPLING

- 12 maize samples were collected from two locations, all three tilage treatments and in replicates in accordance with EC 401/2006; soil samples were also analysed using same procedure

SAMPLE PREPARATION (Sulyok et al., 2020.)

- 5 g of homogenized and grinded wheat sample is extracted with AcN/W/HAc = 79:20:1 (v/v/v)
- After 90 min on rotary shaker (180 RPM) at room temperature 500 µL of the sample is diluted with 500 µL AcN/W/HAc = 20:79:1 (v/v/v), capped and 5 µL was analysed on LC-MS/MS

LC-MS/MS

LC: Agilent 1290

MS: AB Sciex Q-Trap® 5500

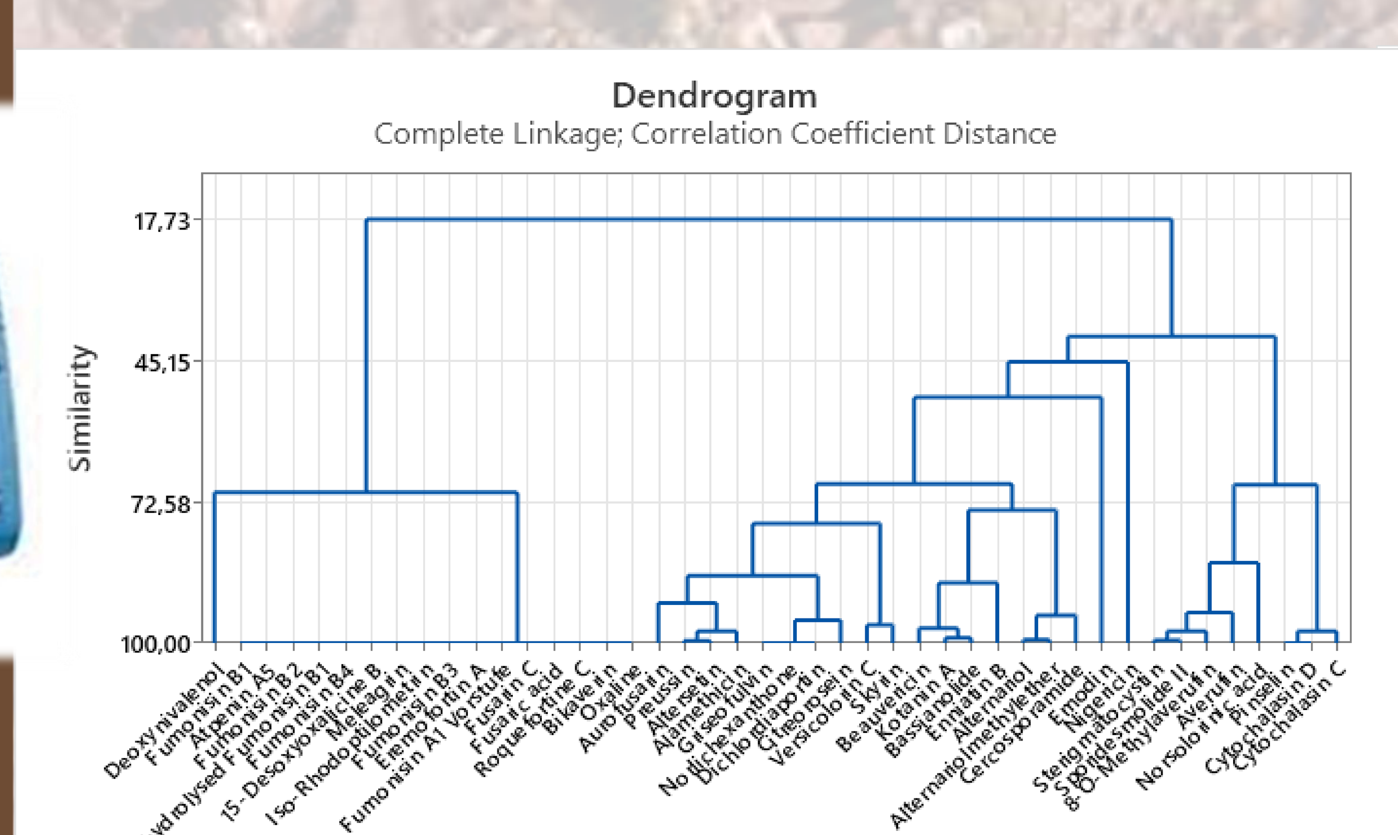
Flow: 1 ml/min

Temperature 25°C

Eluens:

A: MeOH/W/Hac = 10:89:1 (v/v/v) + 5 mM CH_3COONH_4

B: MeOH/W/Hac = 97:2:1 (v/v/v) + 5 mM CH_3COONH_4



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