Julius Kühn-Institut
Federal Research Centre for Cultivated Plants

LupiBreed

– from Breeding research to new cultivars in Germany –

Part II: protein and alkaloid content

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Gefördert durch:
Bundesministerium für Ernährung und Landwirtschaft
aufgrund eines Beschlusses des Deutschen Bundestages

ptble
Projektträger Bundesanstalt für Landwirtschaft und Ernährung

Aims of the consortium

Part I (Helge Flüss, JKI Institut for Breeding Research on Agricultural Crops)
YIELD POTENTIAL AND YIELD STABILITY

Part II (Anne Zaar, JKI Institute for Resistance Research and Stress Tolerance)

1. Proteincontent
2. Alkaloidcontent
3. Correlation Alkaloid-/Proteincontent

LupiBreed

The innovative approach of the project was the integration of new genetic variability from (I) a mutant collection and (II) genetic resources.

Special attention was paid to high protein content and at the same time low alkaloid content.

Low alkaloid content of lupin seed is a main condition for human food and feed production.

Selection of novel lines with low and stable alkaloid values may build the basis of novel successful varieties.

Therefore, the content of the individual alkaloids was also characterized by GC-FID.

LupiBreed (2015 – 2016)

(I) a mutant collection: **: 44 lines**

2015
- 22 early mutant lines (A)
- 22 late mutant lines (B)

2016
- 22 early mutant lines (A)
- 22 late mutant lines (B)

(II) genetic resources**: 230 accessions**

2015
- 96 accessions from Saatzucht Steinach GmbH & Co
- 5 accessions from IPK Gatersleben

2016
- 114 accessions from Saatzucht Steinach GmbH & Co
- 15 accessions from IPK Gatersleben

1. Proteincontent [% of dry matter]

(I) a mutant collection: **:** **44 lines**

2015

	Proteincontent A [% dm]	Proteincontent B [% dm]
total		
mean value	32.57	34.48
minimum	27.24	22.70
maximum	35.99	42.05

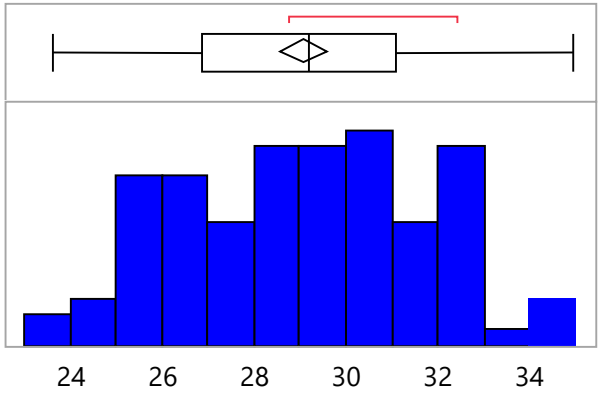
2016

	Proteincontent A [% dm]	Proteincontent B [% dm]
total		
mean value	34.93	35.36
minimum	30.77	32.39
maximum	38.48	38.83

1. Proteincontent [% of dry matter]

(II) genetic resources: **230 accessions**

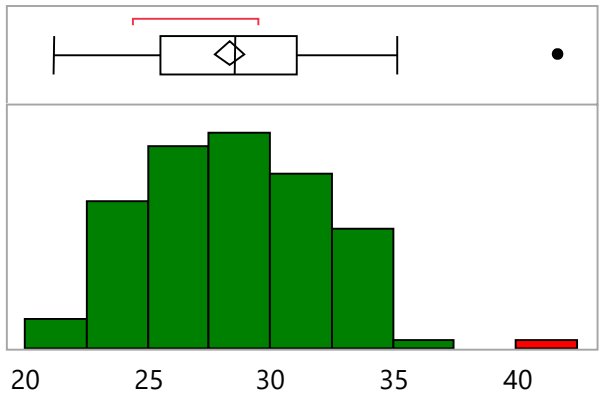
2015



quantile		
100.0 %	Maximum	34.93
99.5 %		34.93
97.5 %		34.6685
90.0 %		32.383
75.0 %	Quartil	31.06
50.0 %	Median	29.155
25.0 %	Quartil	26.8425
10.0 %		25.667
2.5 %		23.90475
0.5 %		23.56
0.0 %	Minimum	23.56

statistical characteristic	
mean value	29.0602
standard deviation	2.6167649
standard error mean	0.2616765
95% KI above mean	29.579423
95% KI under mean	28.540977
N	100

2016



quantile		
100.0 %	Maximum	41.76
99.5 %		41.76
97.5 %		34.6275
90.0 %		32.76
75.0 %	Quartil	31.055
50.0 %	Median	28.47
25.0 %	Quartil	25.48
10.0 %		23.71
2.5 %		21.9175
0.5 %		21.07
0.0 %	Minimum	21.07

statistical characteristic	
mean value	28.334961
standard deviation	3.5659166
standard error mean	0.3139614
95% KI above mean	28.956188
95% KI under mean	27.713735
N	129

1. Proteincontent [% of dry matter]

(II) genetic resources: **230 accessions**

2015

(-) %

Nr.	Acc.	%
4	142	23.56
1	138	23.70
8	154	24.09
3	140	24.73
65	155	24.73
2	139	25.20
54	132	25.27
47	102	25.59
51	111	25.64
53	118	25.66

(+) %

Nr.	Acc.	%
34	5286	34.93
29	5270	34.70
36	5291	34.64
67	491	33.85
89	1078	32.87
40	5335	32.81
64	152	32.78
66	159	32.41
102	L 5448	32.41
35	5290	32.39

2016

(-) %

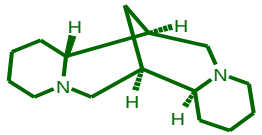
Nr.	Acc.	%
68	6566	21.07
61	6554	21.56
69	6567	21.84
101	6665	22.15
97	6657	22.54
126	7001	22.89
80	6595	22.93
62	6557	22.96
66	6563	23.10
99	6659	23.63

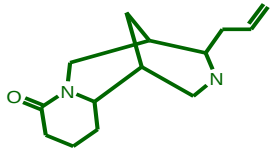
(+) %

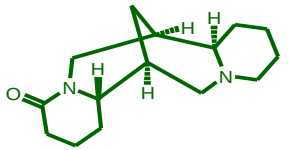
Nr.	Acc.	%
112	6680	**41.76**
29	L 5361	35.16
39	L 5503	34.83
107	6672	34.02
31	L 5448	34.02
28	L 5360	33.72
25	L 1157	33.55
73	L 6571	33.51
10	L 1114	33.43
119	6691	32.95

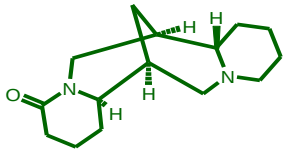
2. Alkaloidcontent

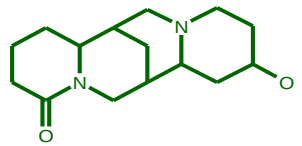
typical chromatogram of alkaloids from lupine seeds (*Lupinus angustifolius)*











2. Alkaloidcontent [of dry matter]

(I) a mutant collection: **:** **44 lines**

2015

	Alkaloidcontent A [µg/g]	Alkaloidcontent B [µg/g]
total		
mean value	195.85	300.12
minimum	28.39	15.33
maximum	539.90	944.95

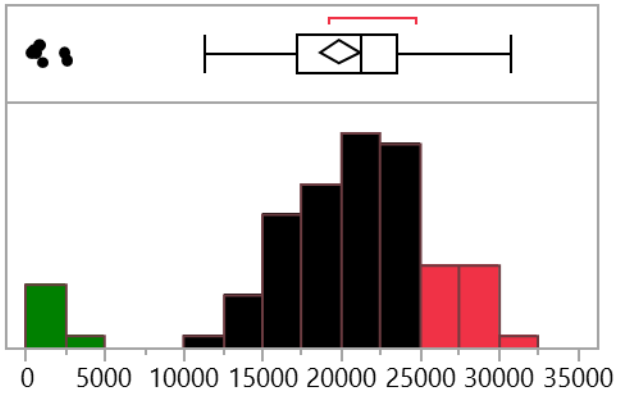
2016

	Alkaloidcontent A [µg/g]	Alkaloidcontent B [µg/g]
total		
mean value	359.97	625.88
minimum	113.68	112.41
maximum	726.88	1430.79

2. Alkaloidcontent [of dry matter]

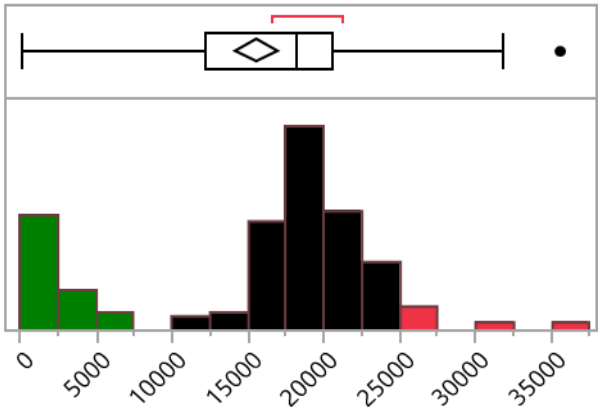
(II) genetic resources: **230 accessions**

2015



Year	Nr.	Accession	Alkaloid [µg/g]
2015	100	L 147	362
2015	9	5250	471
2015	6	147	656
2015	64	152	860
2015	11	5276	1057
2015	99	L 6518	2444
2015	12	101	2618
2015	37	5300	11268
2015	65	155	14445
2015	97	L 5360	29539
2015	66	159	30774

2016

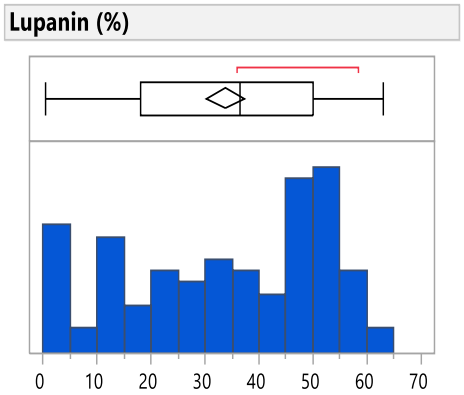


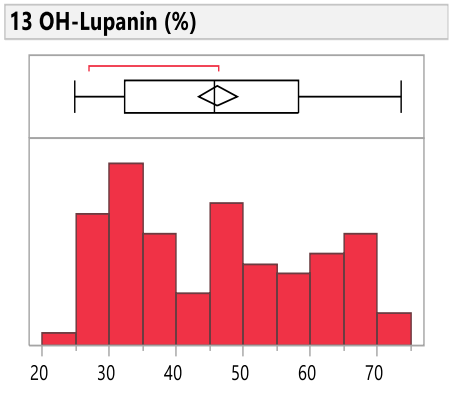
Year	Nr.	Accession	Alkaloid [µg/g]
2016	14	1126	171
2016	13	1125	333
2016	126	7001	339
2016	112	6680	435
2016	73	L 6571	451
2016	69	6567	626
2016	64	6560	640
2016	119	6691	25473
2016	24	1155	26281
2016	18	1130	31844
2016	17	1129	35604

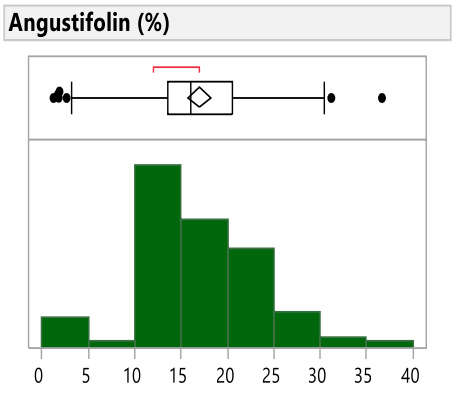
2. Alkaloidcontent [% of dry matter]

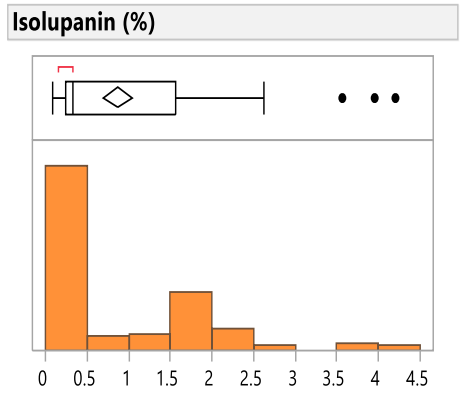
(II) genetic resources: **230 accessions**

2015

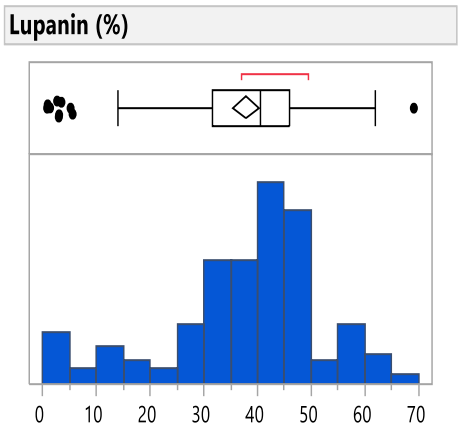


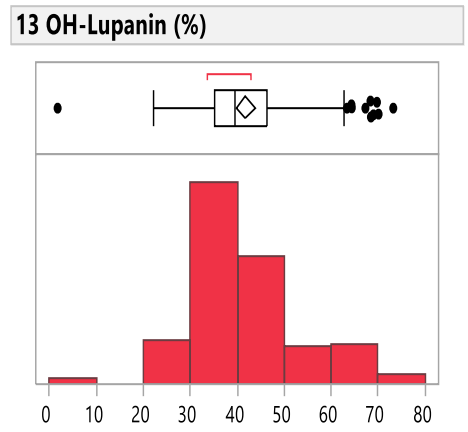


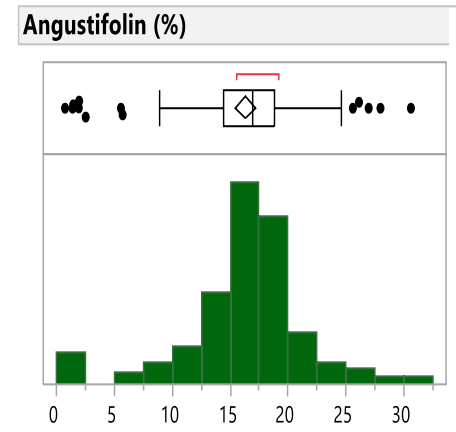


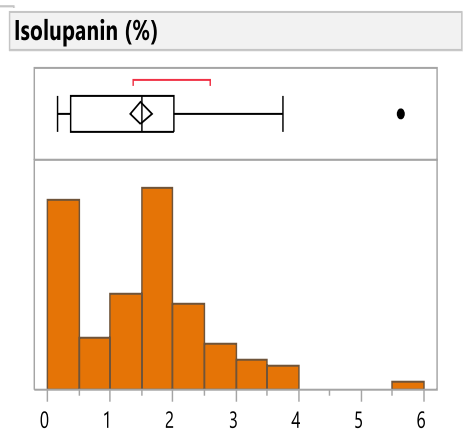


2016



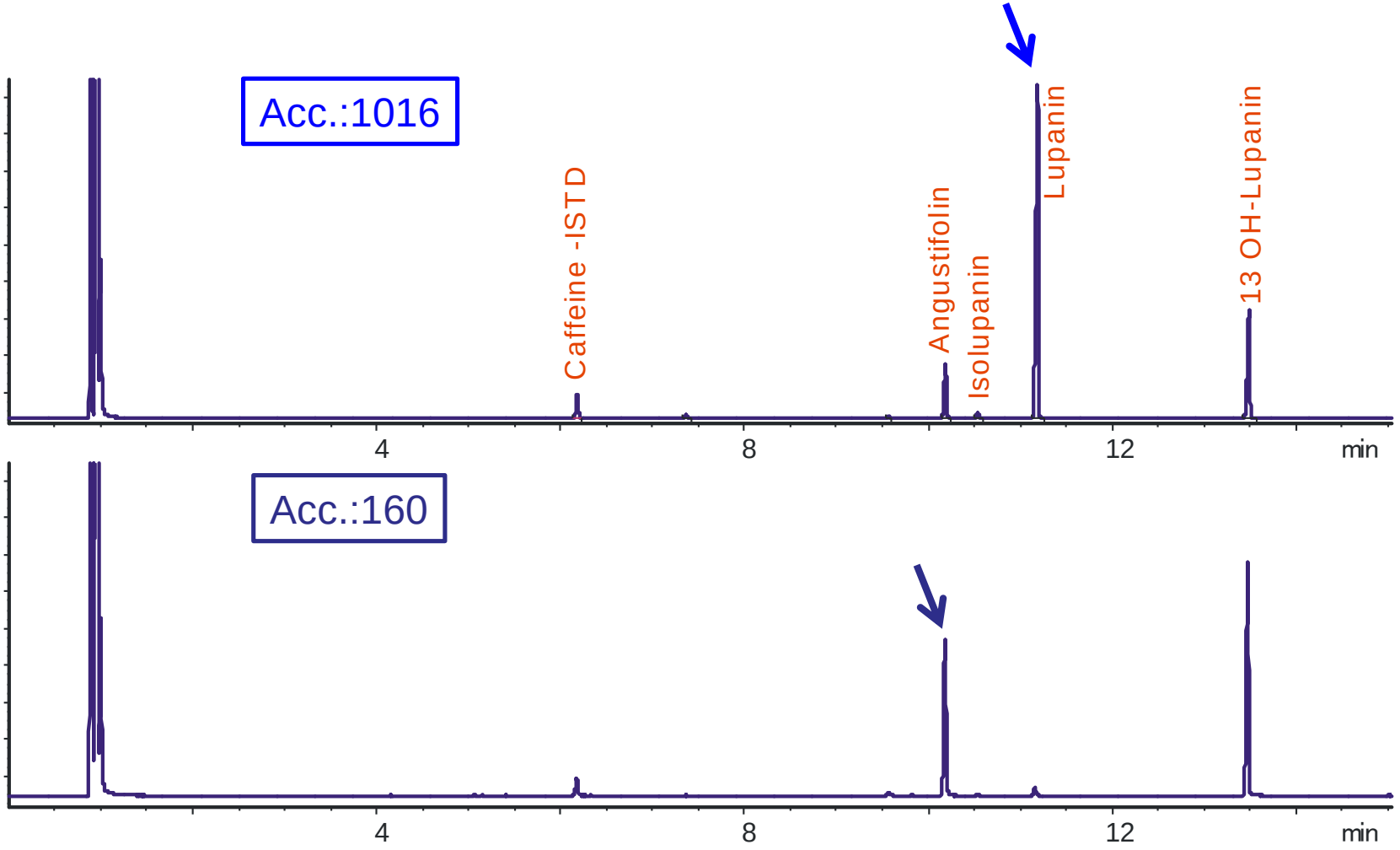






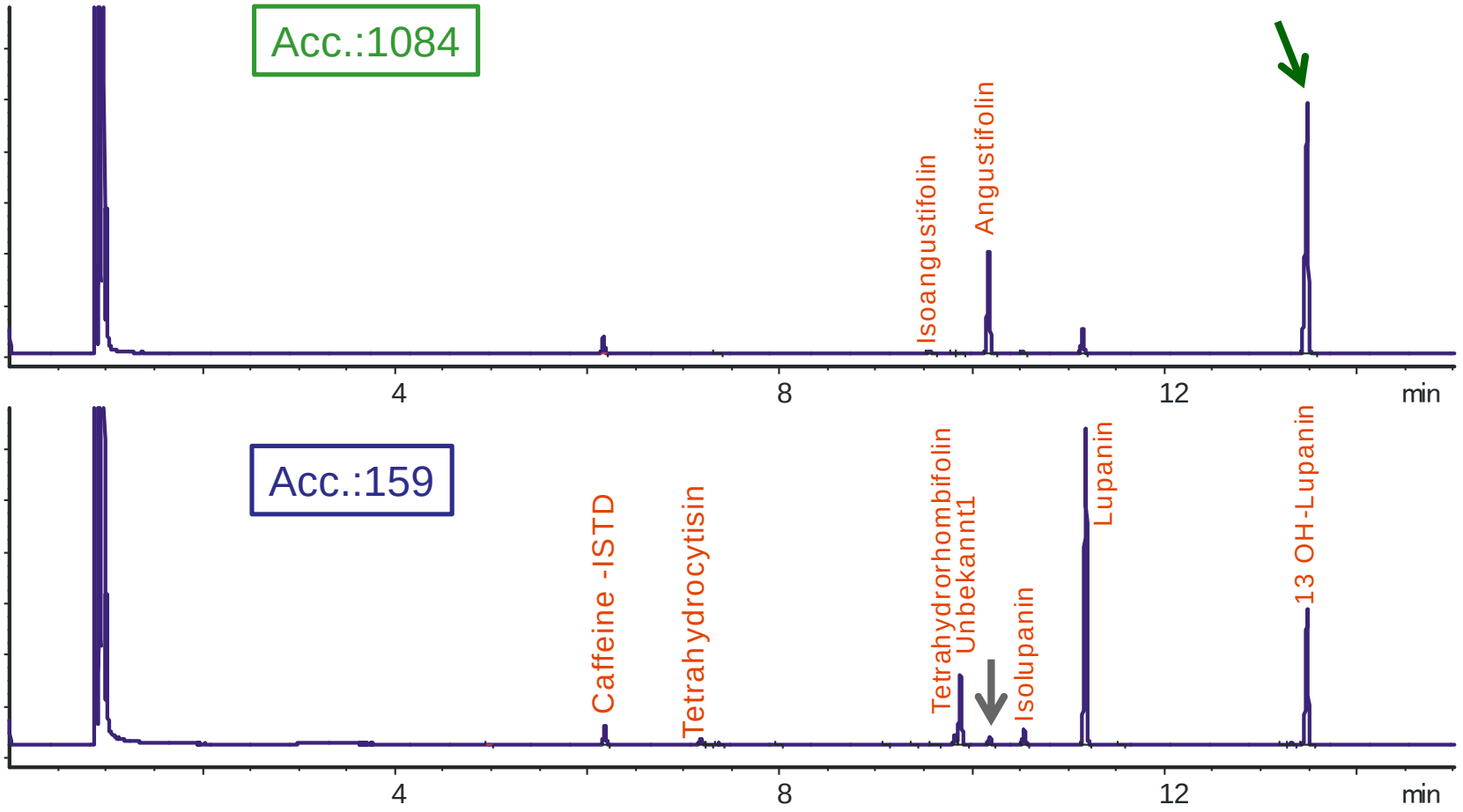
2. Alkaloidcontent [% of dry matter]

(II) genetic resources: **230 accessions**

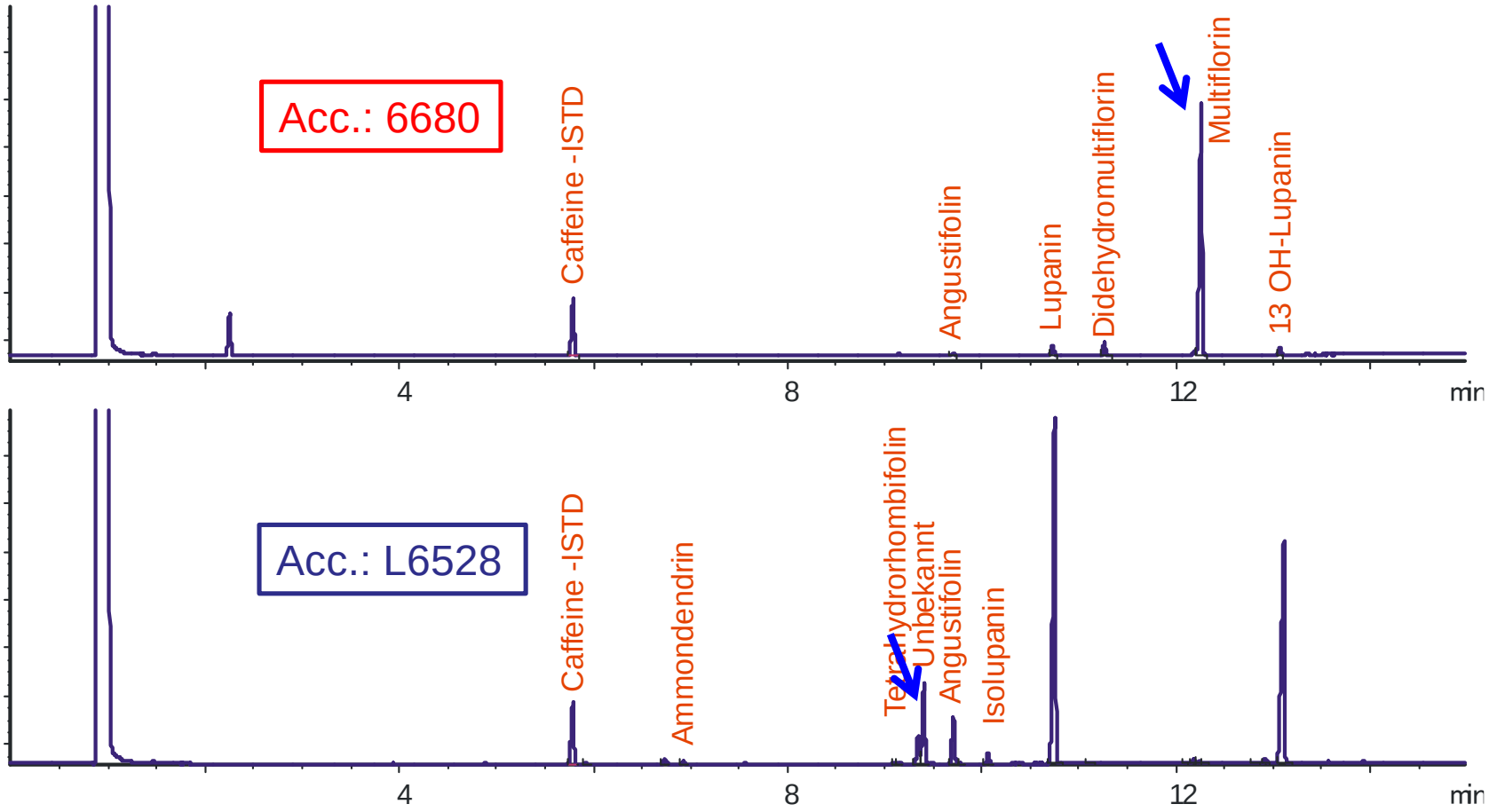


2. Alkaloidcontent [% of dry matter]

(II) genetic resources: **230 accessions**



2. Alkaloidcontent [% of dry matter]



2. Alkaloidcontent - Summary

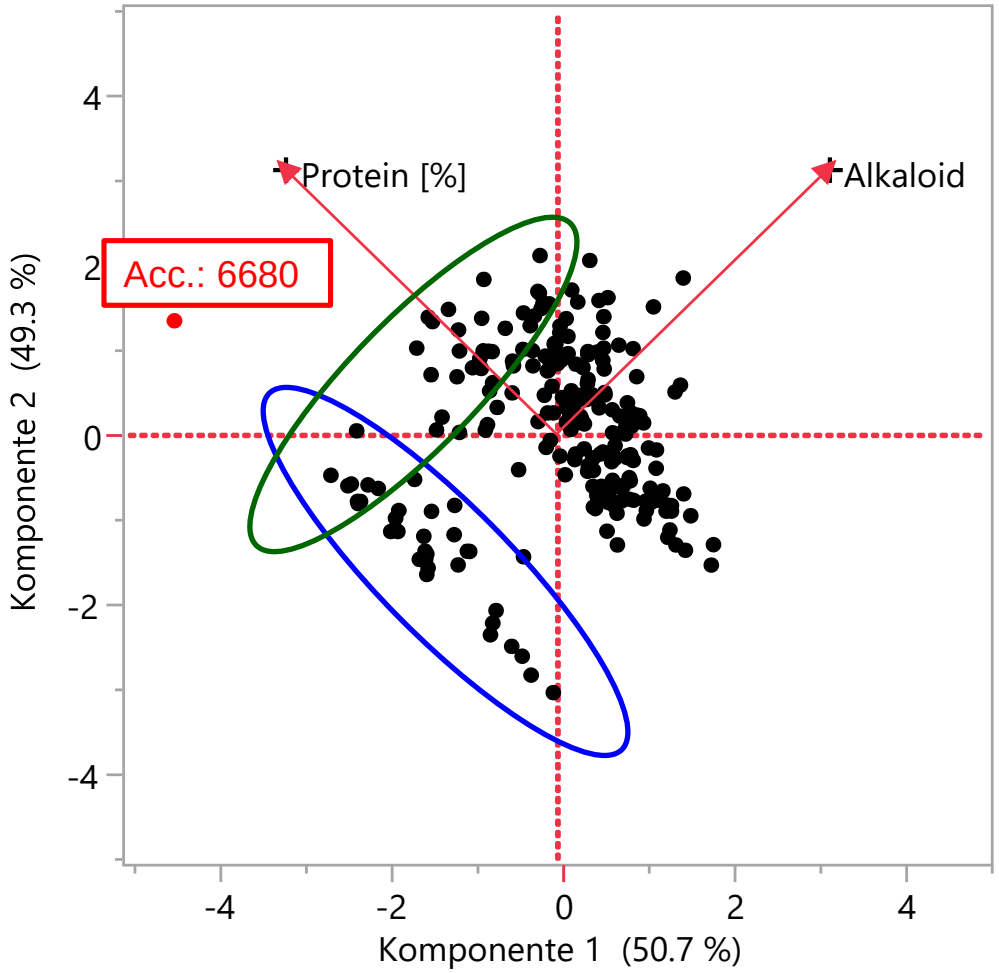
(II) genetic resources: **230 accessions**

- Ratio of the main alkaloids
  - Lupanin 0.5 – 69.2 %
  - 13OH-Lupanin 1.7 – 73.5 %
  - Angustifolin 0.7 – 36.7 %
  - Isolupanin 0.1 – 5.6 %

- other alkaloids
  - Multiflorin until 6.9 % (90.1%)
  - Tetrahydrorhombifolin until 10.4 %
  - Ammondendrin until 5.7 %
  - Unknown until 12.1 %
  - Spartein until 0.5 %

3. Correlation Alkaloid-/Proteincontent

(II) genetic resources: **230 accessions**



Year	Nr.	Accession	Alkaloid [µg/g]	Protein [%]
2016	112	6680	435.11	41.76
2016	107	6672	4952.75	34.02
2016	73	L 6571	451.36	33.51
2015	64	152	860.34	32.78
2016	127	147	2196.52	32.27
2015	9	5250	470.60	32.11
2015	100	L 147	362.31	32.03
2015	12	101	2618.24	31.91
2016	118	6690	5513.54	31.19

3. Correlation Alkaloid-/Proteincontent

(II) genetic resources: **230 accessions**

- Alkaloid
  - 16 accessions < 1000 µg/g (0.1 %)
  - 34 accessions < 5000 µg/g (0.5 %)

- Protein
  - 13 accessions > 33 % dry matter
  - 38 accessions > 32 % dry matter

Alkaloidcontent < 1000 µg/g and
Proteincontent > 32 % dry matter

Year	Nr.	Accession
2016	112	6680
2016	73	L 6571
2015	64	152
2015	9	5250
2015	100	L 147
2015	6	147

6 accessions

Alkaloidcontent < 5000 µg/g and
Proteincontent > 33 % dry matter

Year	Nr.	Accession
2016	112	6680
2016	73	L 6571
2016	107	6672

3 accessions

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Projektträger Bundesanstalt
für Landwirtschaft und Ernährung

Gefördert durch:
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für Ernährung
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aufgrund eines Beschlusses
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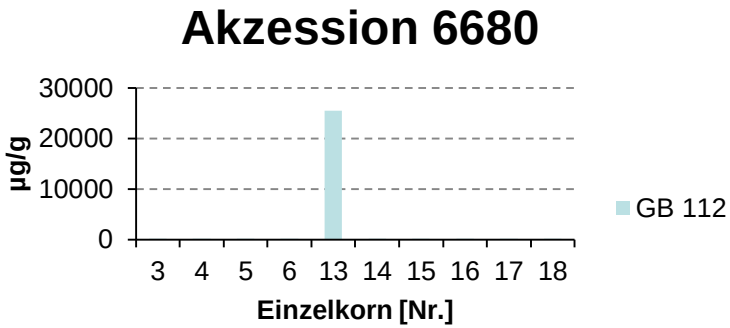
Gisela Jansen
Hans-Ulrich Jürgens
Sylvia Seddig

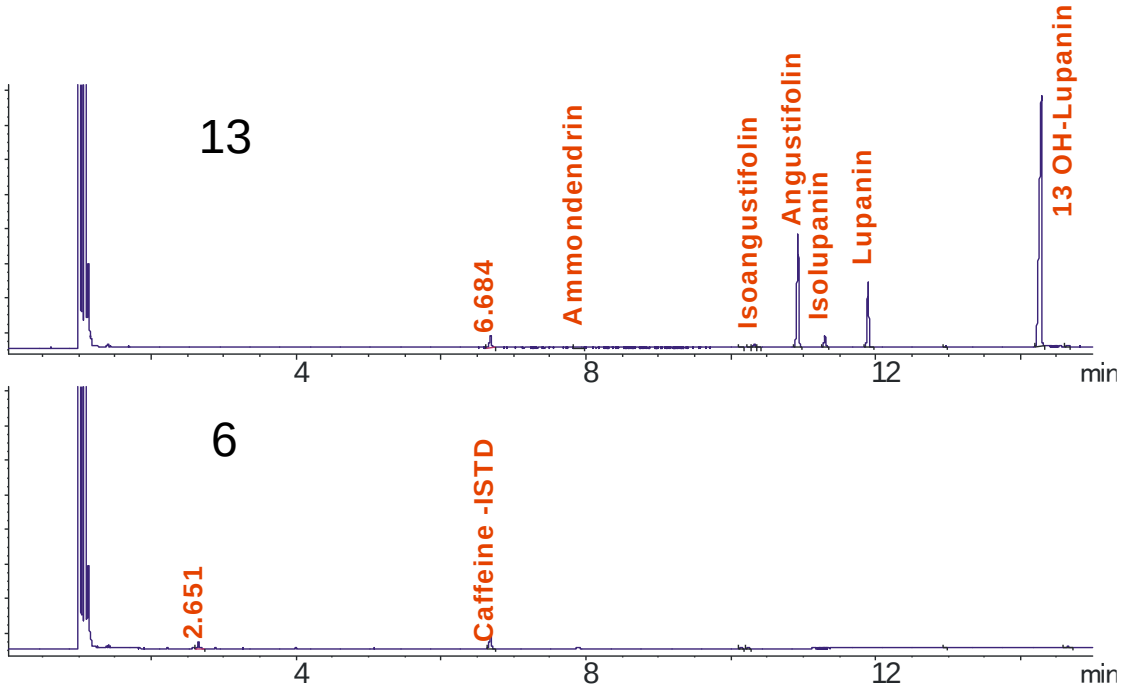
Ulrike Lohwasser
Matthias Kotter

Regine Dieterich
Anna Beyer

Thank you for your attention

4. Accession 6680





2. Alkaloidcontent

(II) genetic resources: **230 accessions**