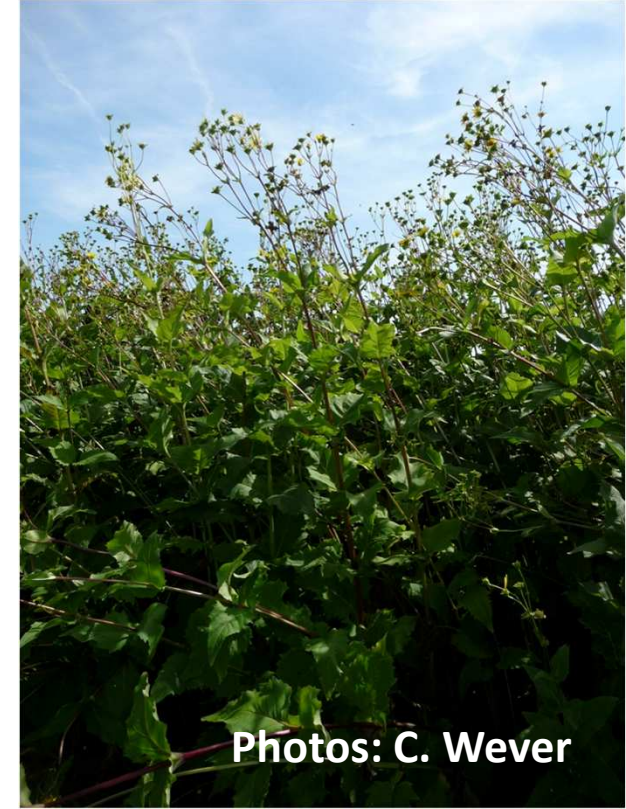


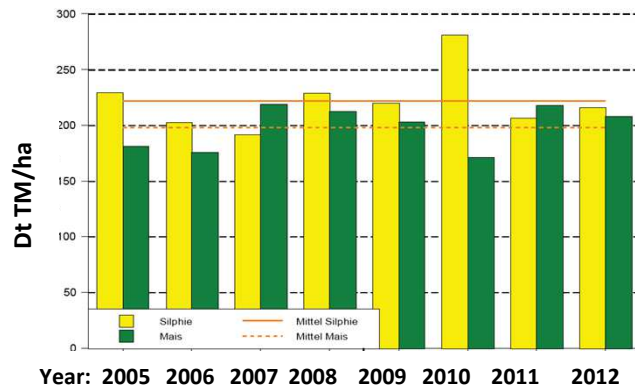
SPREAD: *Silphium Perfoliatum* Resource Evaluation and Development



Photos: C. Wever

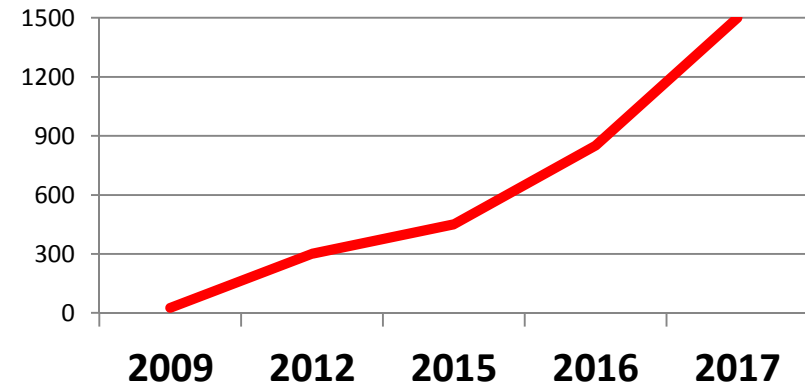
Durchwachsene Silphie in der Landwirtschaft

Biomasseertrag der Silphie / Mais



FNR project report 2013 (Thüringer Landessanstalt für Landwirtschaft - TLL)

Anbaufläche in Deutschland (ha)



Ziel des SPREAD-Projektes

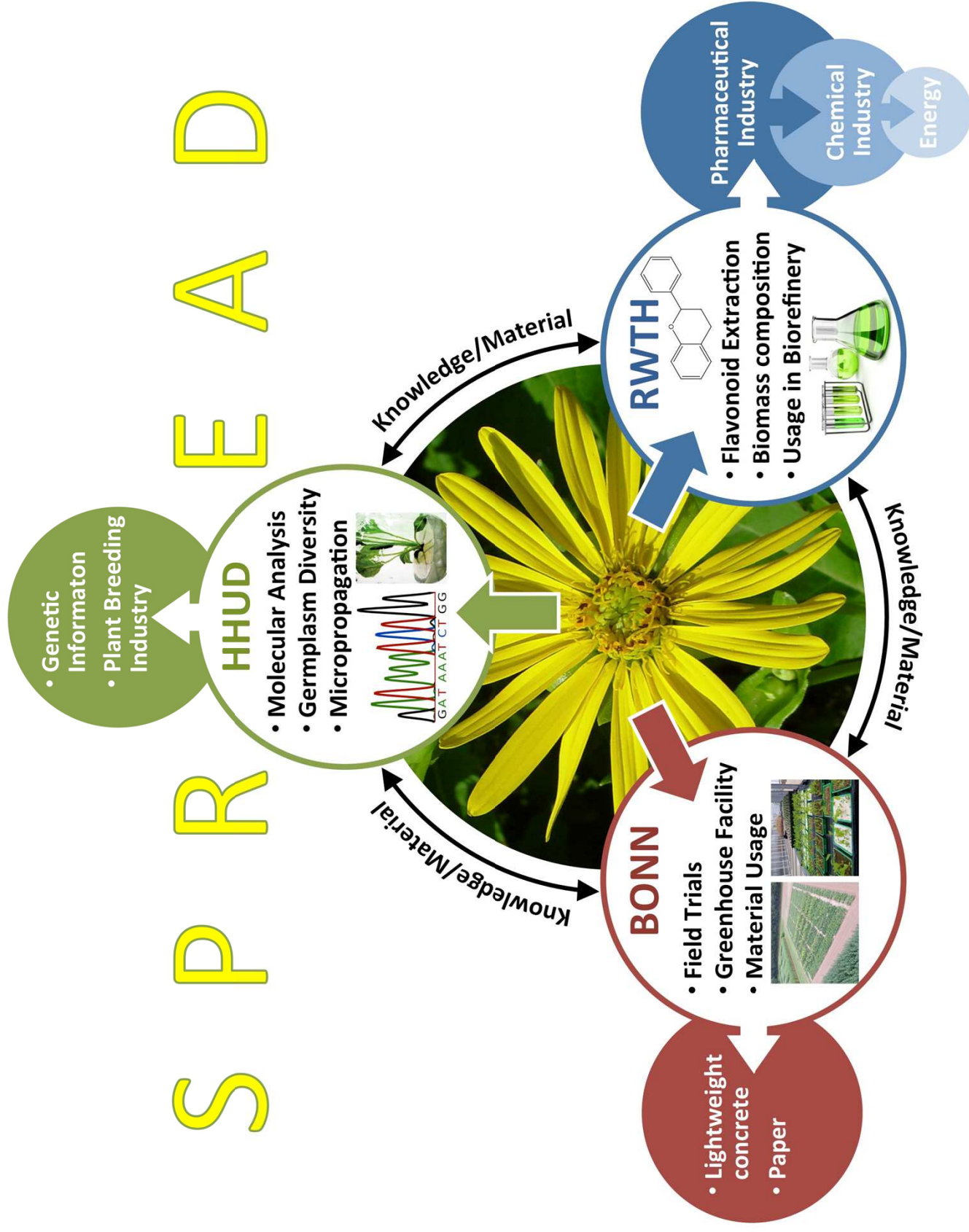
Anbau von Silphie profitabler zu machen



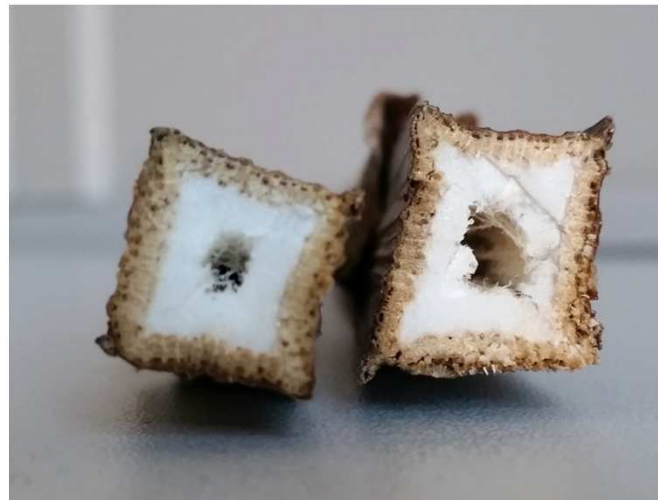
- Das Potential der Silphie als nachwachsendem Rohstoff für neue industrielle Anwendungen zu erforschen
- Einen Grundstein für die Etablierung eines Zuchtprogramms zu legen



SPR EAD



Potential für die stoffliche Nutzung



Martin Höller, Ralf Pude

Leichtbeton und Schüttdämmung



Lightweight and air-entrained lightweight concrete

Silphium : cement (2:3)

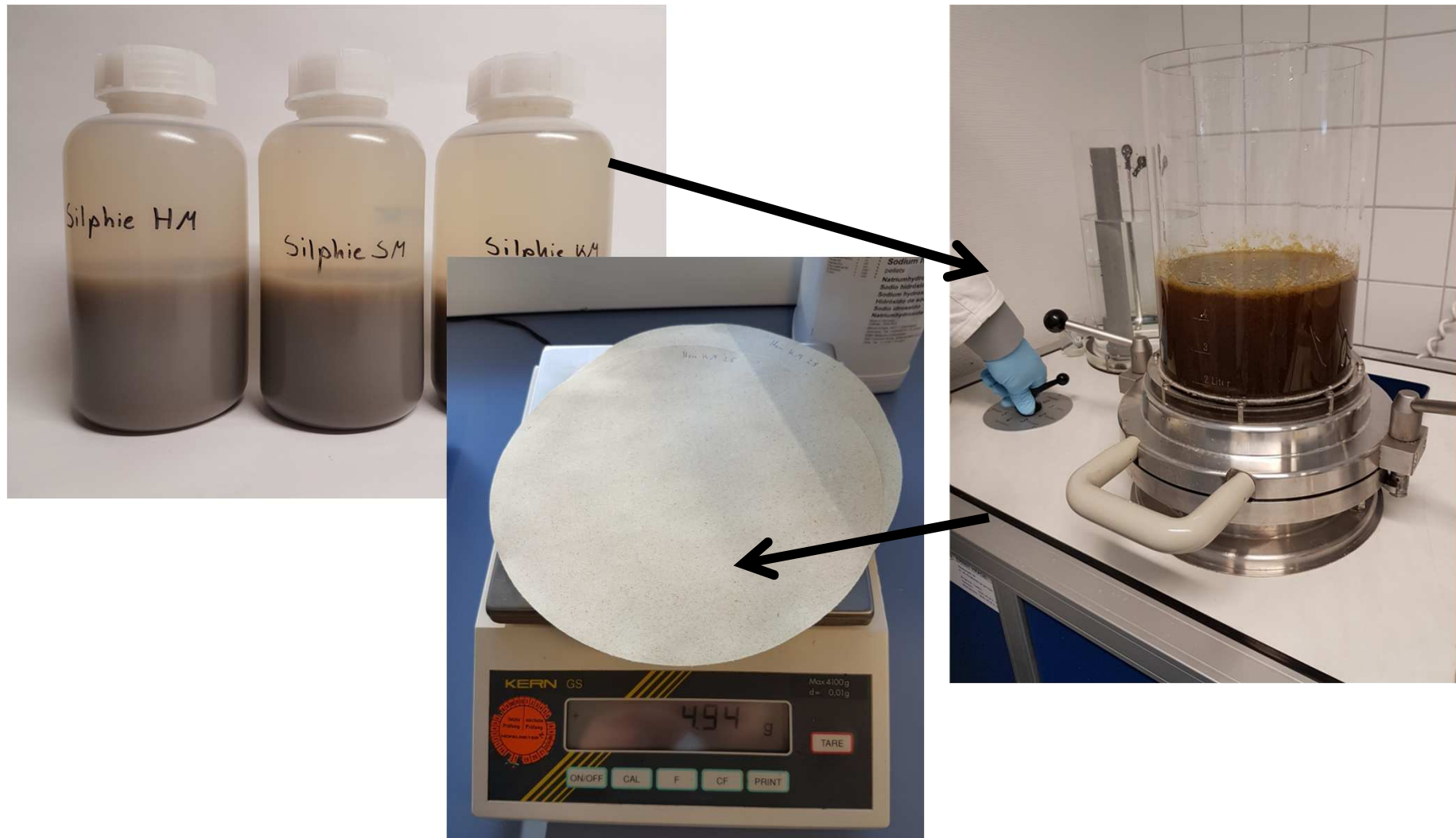
Substitution of expanded polystyrene (EPS) by Silphium particles.

The 37,5% *Silphium* sample shows a **similar compressive strength** with a **19% improvement of the thermal conductivity** compared to the 100% EPS standard.



Martin Höller, Ralf Pude

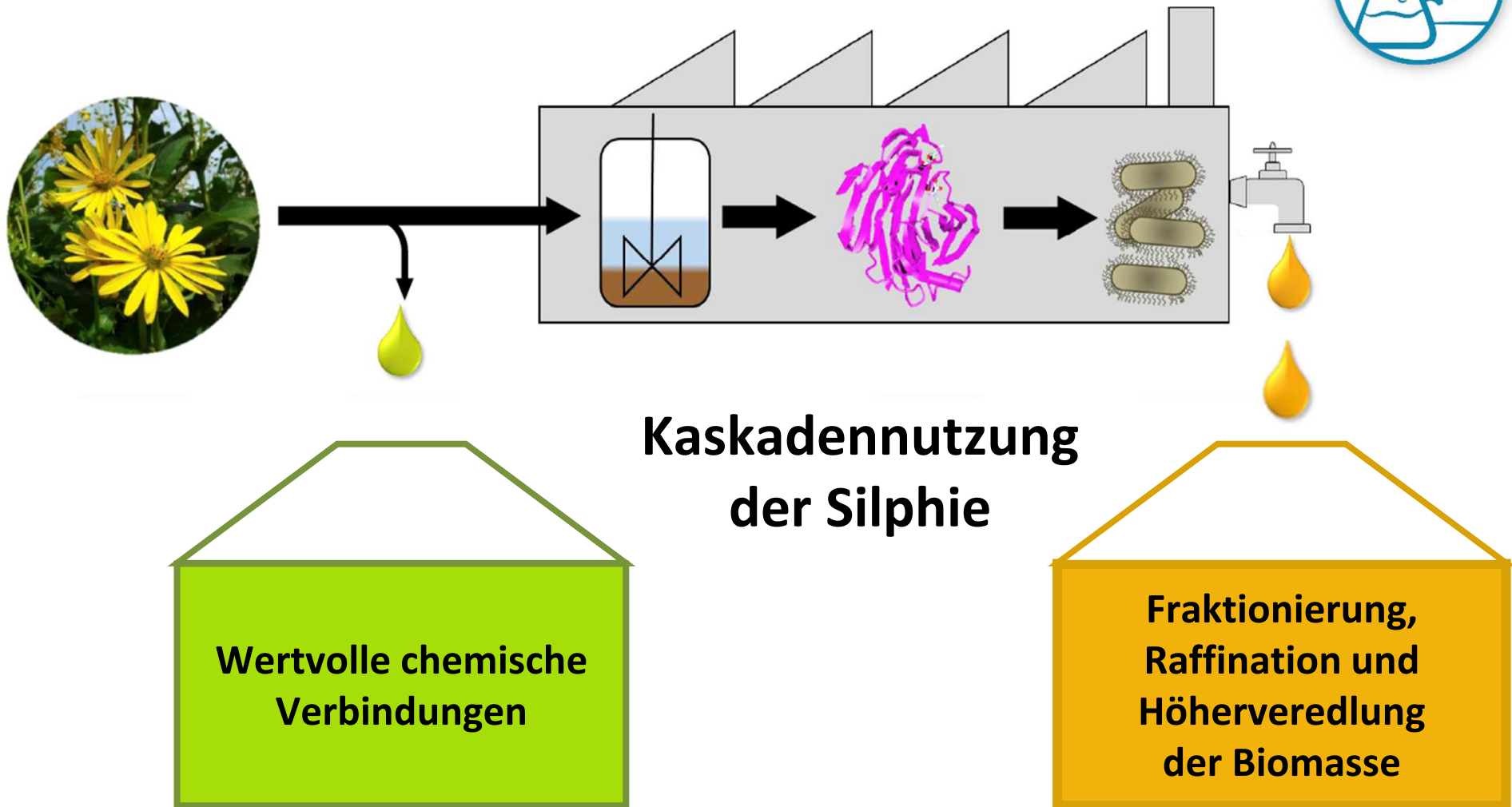
Papier aus Silphie



Paper from 100% Silphium cellulose has a higher tensile strength ($650\text{--}1750\text{ N m}^{-1}$) compared to recycled paper (490 N m^{-1}).

Martin Höller

Schematischer Bioraffinerie-Ablauf





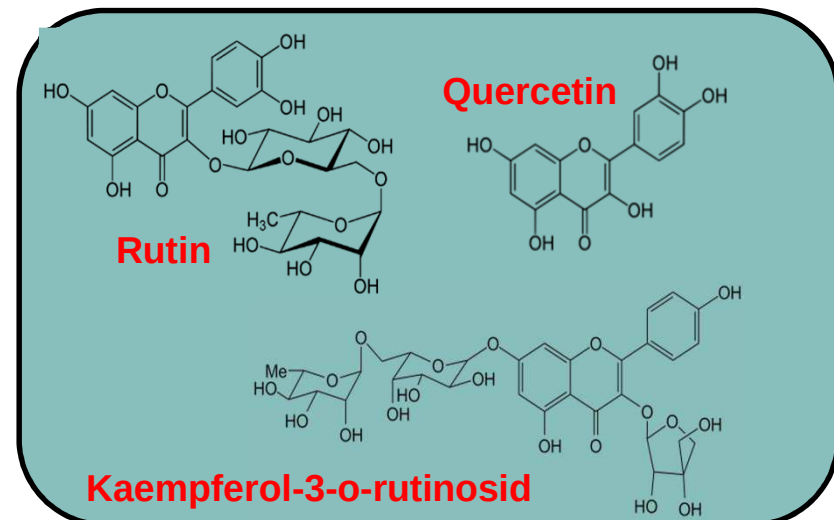
Wertvolle Komponente aus Silphie

***Silphie* ist eine Heilpflanze der Indianer**

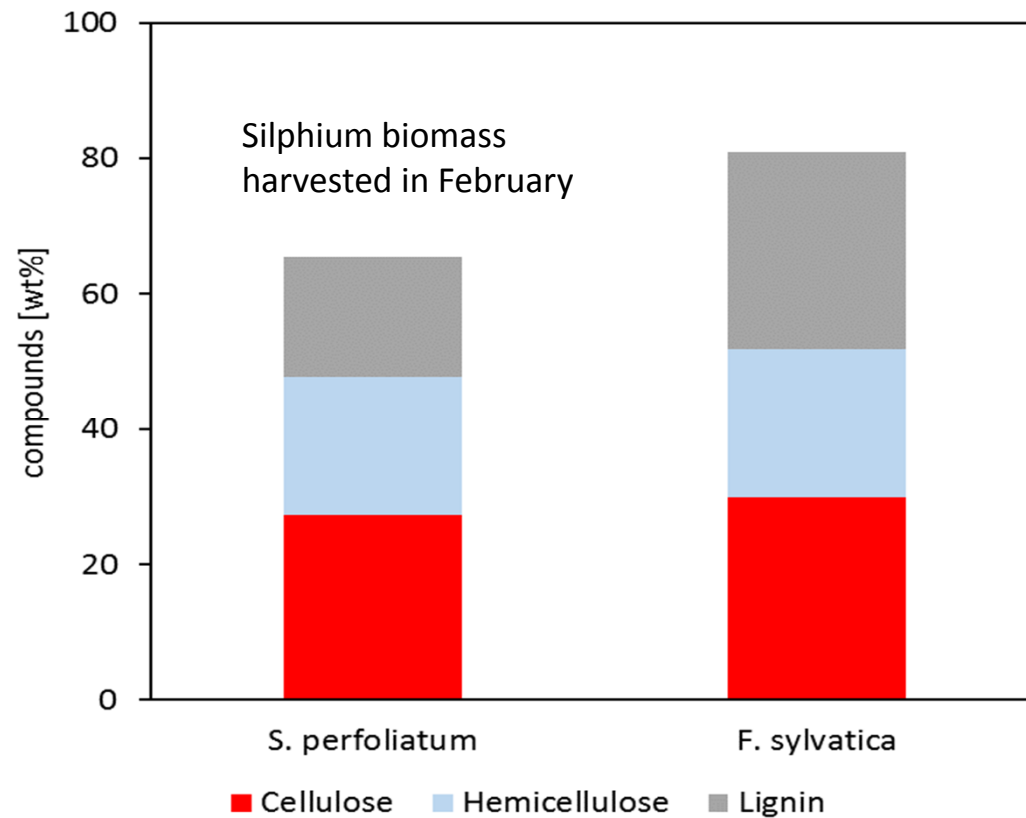


- antioxidant
- entzündungshemmend
- antibakteriell
- antiallergisch
- krebshemmend

Flavonoide



Zusammensetzung der Pflanze



Silphie und Buche haben ähnliche Zellulosegehalte



SPREAD – Verbreitung der Silphie in Europa

- Im 18. Jahrhundert von Nordamerika als Zierpflanze nach Europa gebracht
- Mitte des 20. Jahrhunderts – Bewertung als Futter- und Silage Pflanze in der UdSSR
- Beginn des 21. Jahrhunderts – Benutzung als Bioenergiepflanze

Nur einige Herkünfte / Cultivaren mit unklaren Verwandtschaftsverhältnissen sind in Europa bekannt

Sammlung der "europäischen" Becherpflanzen

<i>Silphium perfoliatum</i> L.	Place	Country	no.
1 „USA“ (TLL)	Jena	USA / Germany	11
2 „East Germany“ (TLL)	Jena	Germany	11
3 „Russia“ (TLL)	Jena	Russia / Germany	11
4 „North Europa“ (TLL)	Jena	North Europe / Germany	11
5 „Ukraine“ (TLL)	Jena	Ukraine / Germany	11
6 Botanic Garden, Loci-Schmidt-Garten	Hamburg	Germany	6
7 Botanic Garden, HHU	Düsseldorf	Germany	6
8 Schau- und Sichtungsgarten Hermannshof e.V. (C. Schmidt)	Weinheim	Germany	6
9 SILP1, IPK Genebank	Gatersleben	Germany	5
10 SILP2, IPK Genebank	Gatersleben	Germany	4
11 „Wisconsin x Arkansas“ (K. Albrecht)	Jülich / Bayreuth	USA / Germany	8
12 Ontario Native Scape	Ontario	Canada	2
13 Botanic Garden, Basel	Pennsylvania	USA / Switzerland	3
14 „ssp. <i>connatum</i> “ (I. Kaczmarek)	Hamburg	USA / Germany	1

Phänotyp der ausgewählten Herkünften



“Ukraine” (TLL)



“Ukraine”



“Russia” (TLL)



“Russia”

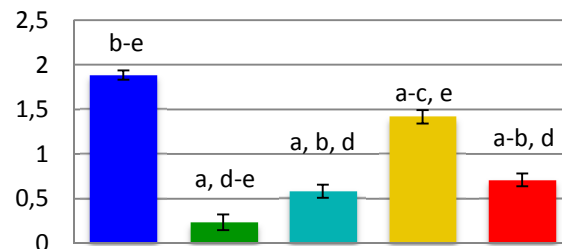


Feldexperimente am Klein Altendorf (Uni Bonn)

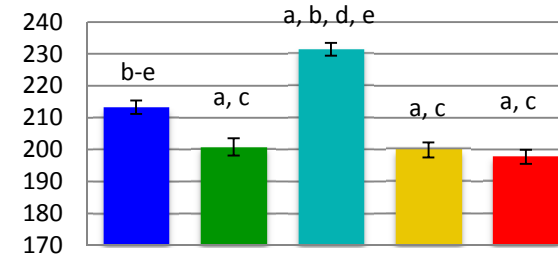


Phänotypische Variationen zwischen Herkünften

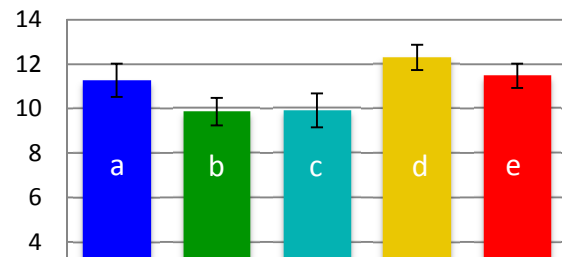
Flowering



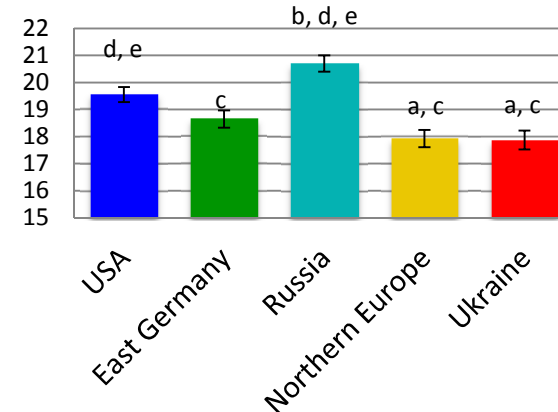
Height



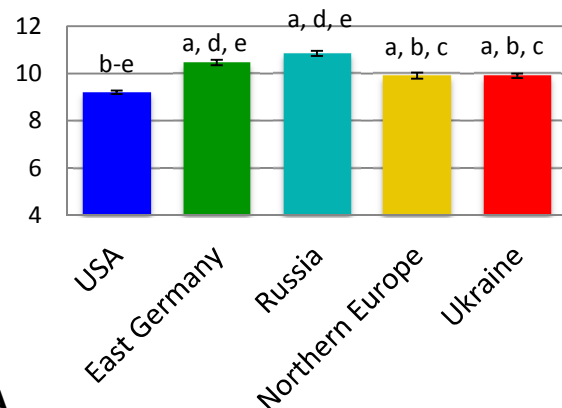
Stalk number



Stem diameter

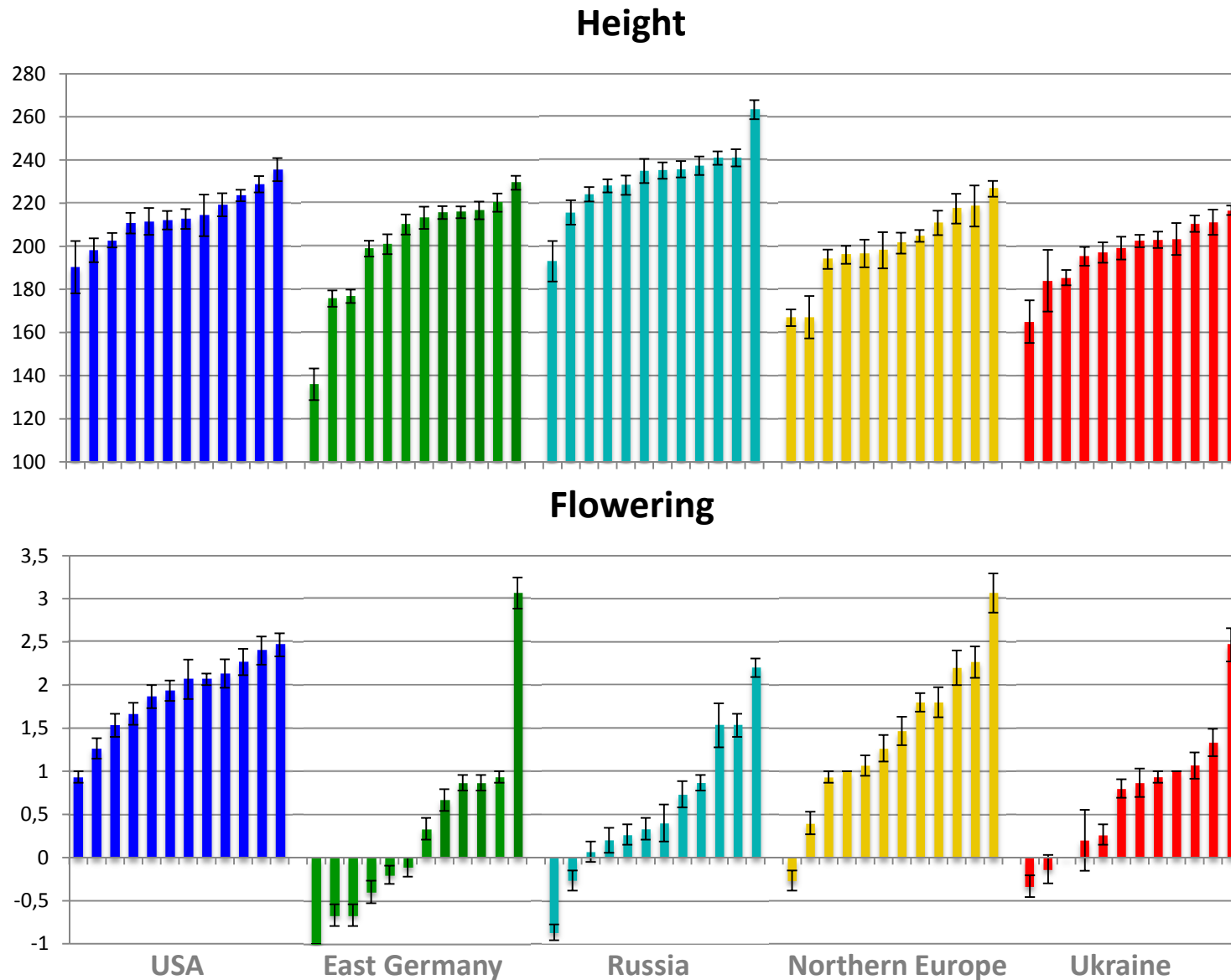


Node number



No. of accessions	5	
No. of clones/genotypes	60	12 per accession
No. of plants	180	3 per genotype
No. of stalks	540	3 per plant

Phänotypische Variationen (innerhalb der Herkünfte)



Genomgröße der Silphie



Arabidopsis thaliana

0.1 GB

Oryza sativa

0.4 GB

Helianthus annuus

2.4 GB

Zea mays

2.5 GB

Silphium perfoliatum

8 GB

Triticum aestivum

16 GB



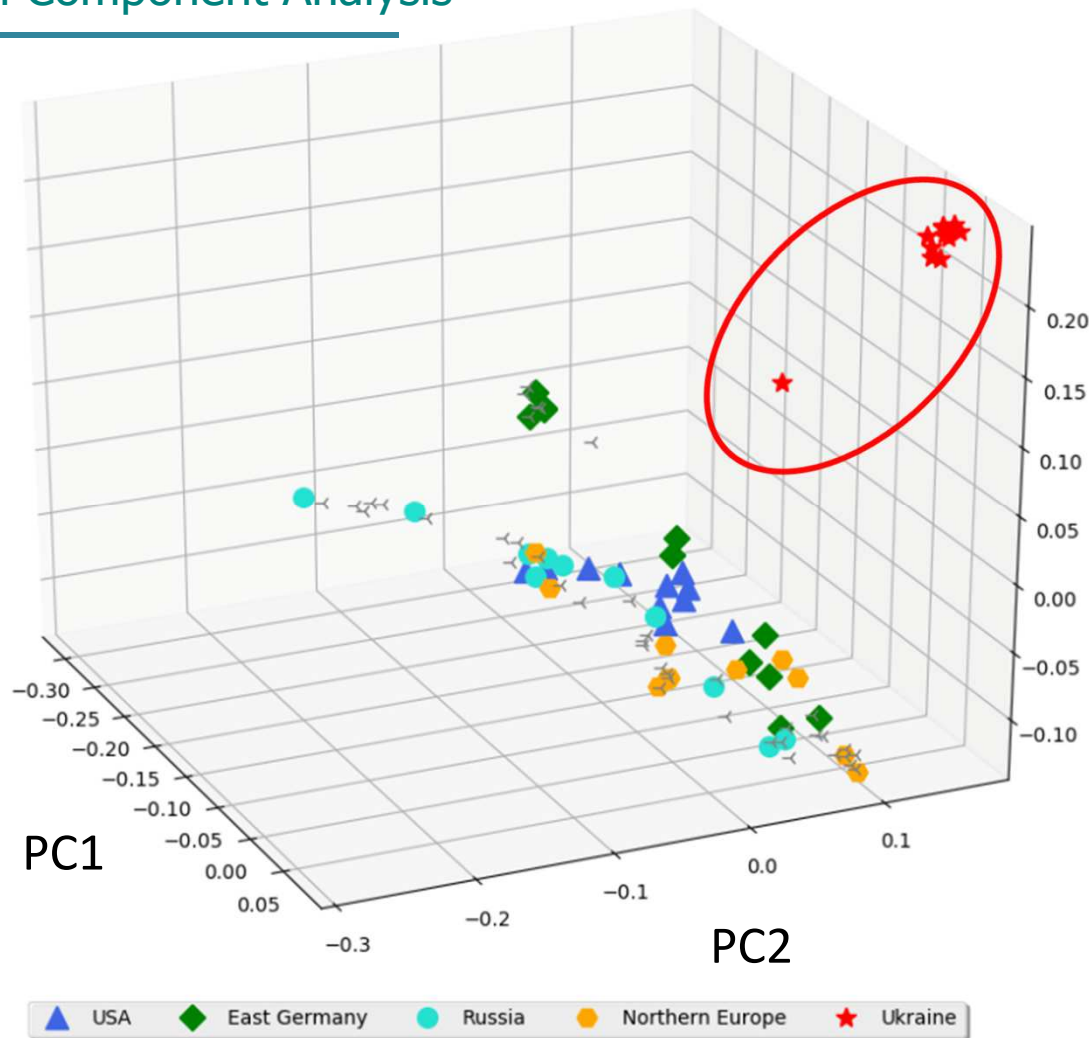
Tunable Genotyping by Sequencing tGBS®

is the cost effective method of choice for genome wide SNP discovery without prior knowledge of the genome sequence.



Genetische Distanzen zwischen 55 Pflanzen der fünf Herkunft

Principal Component Analysis



Ukraine (TLL)

East Germany (TLL)

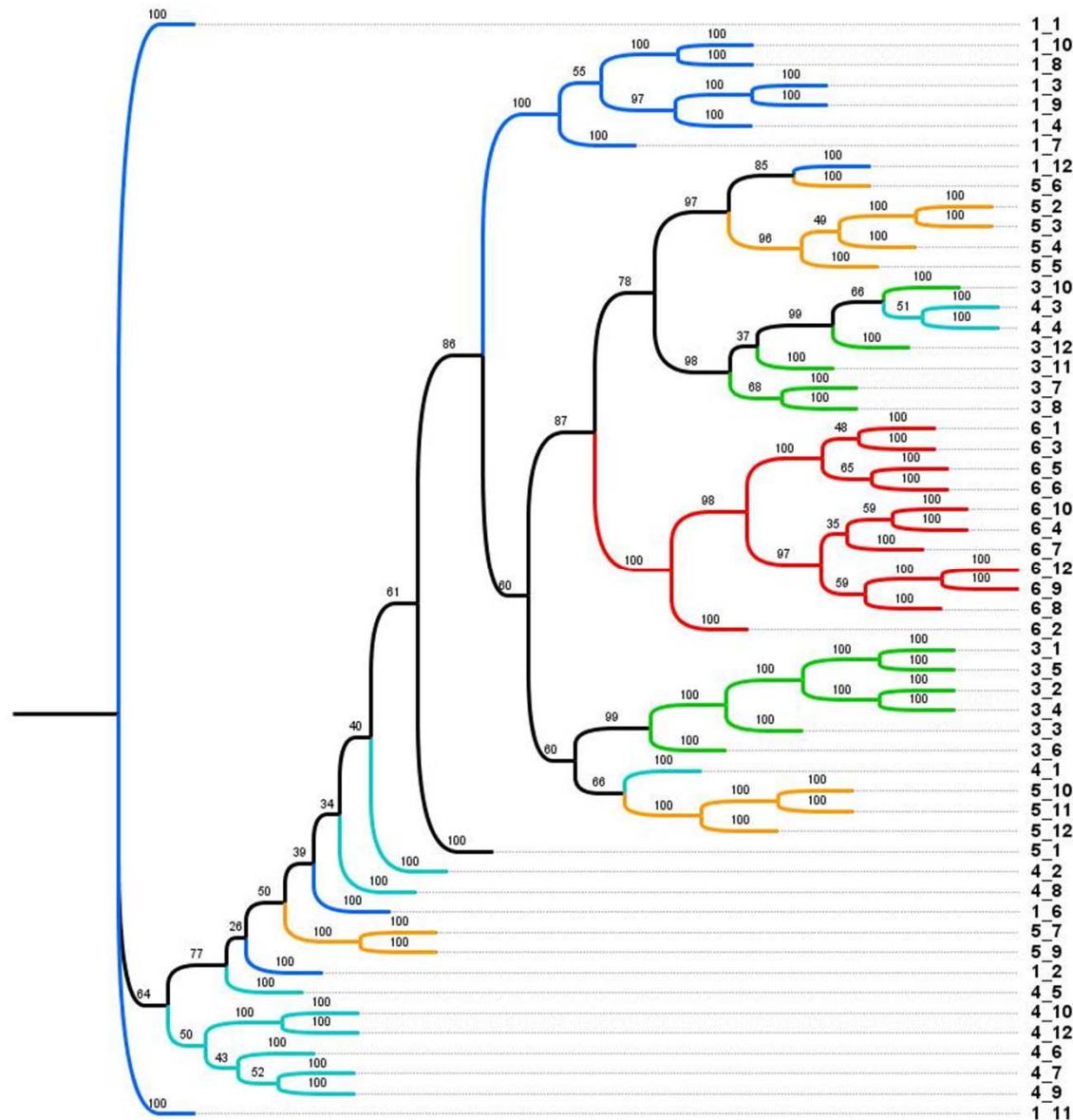
USA (TLL)

Northern Europe (TLL)

Russia (TLL)

PC3

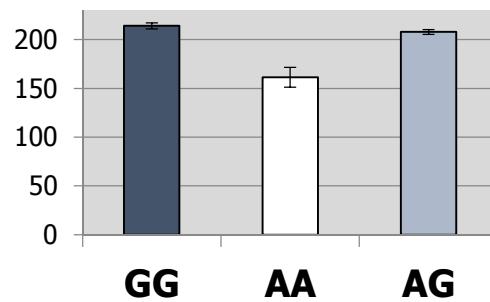
Phylogenetischer Baum



Phänotyp – Genotyp Assoziationen

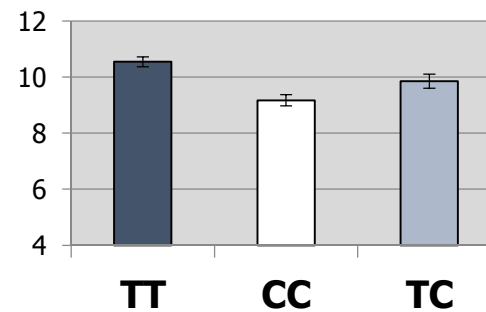
Plant height (cm)

Silphium_51173, $p < 0.0001$



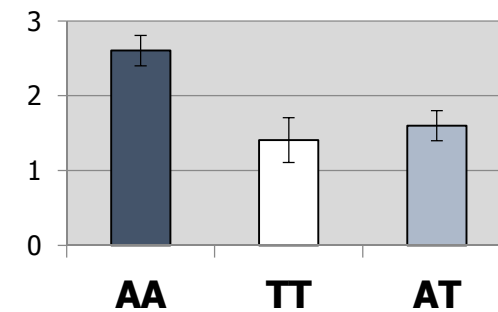
Node number

Silphium_417033, $p < 0.0001$



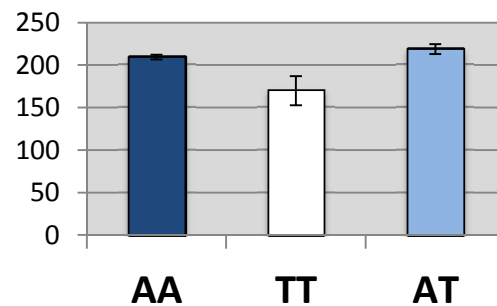
Flowering (no. flower levels)

Silphium_570147, $p < 0.001$



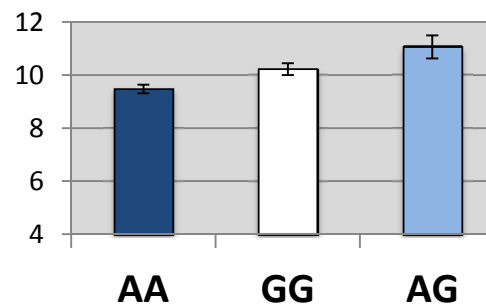
Plant height (cm)

Silphium_1010791, $p < 0.001$



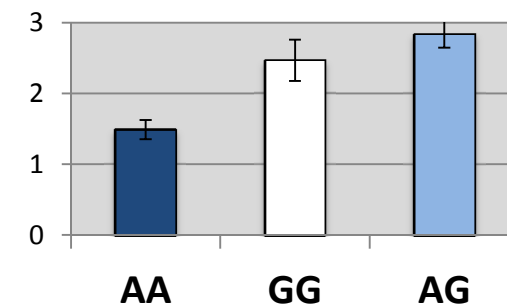
Node number

Silphium_85186, $p < 0.001$



Flowering (no. flower levels)

Silphium_1116226, $p < 0.0001$



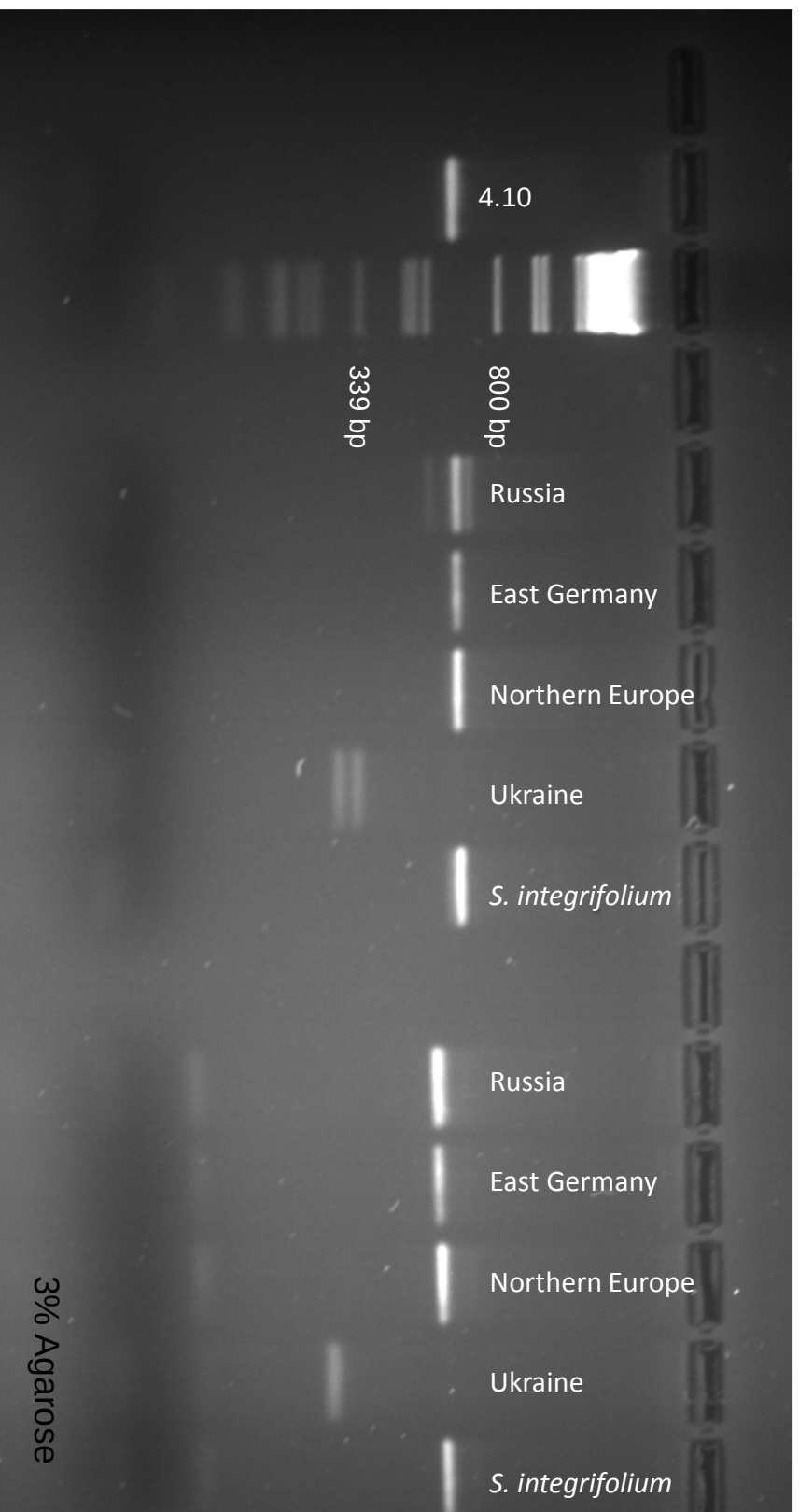
Entwicklung der molekularen Marker

P46

PCR fragment
 λ -PstI

mit VspI geschnitten

mit TaiI geschnitten



Anton Kraege

Acknowledgements

Ministry of Culture and Science
of the German State
of North Rhine-Westphalia

