FiBL 50 JAHRE ANS YEARS

together one step ahead

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LUPINNO SUISSE

Breeding resistant, sweet lupins for the sustainable, regional production of tomorrow

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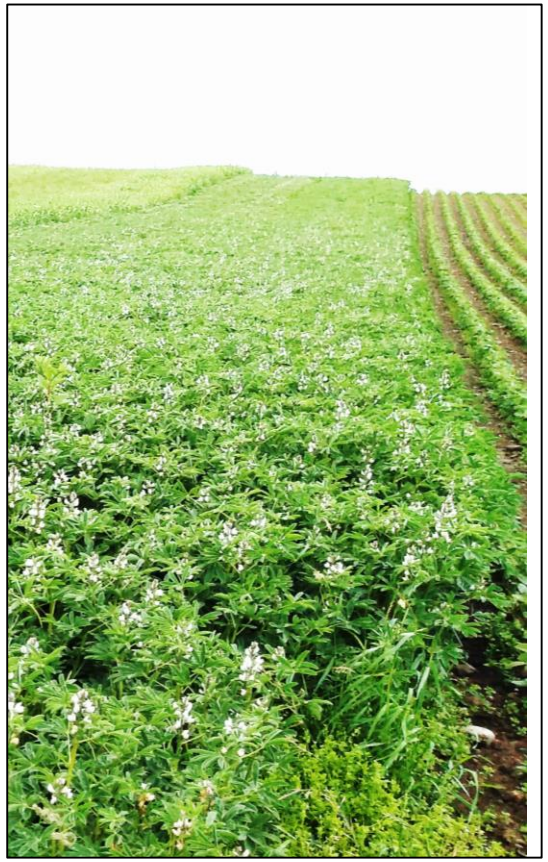
8th Meeting of IG Proteins4Future – Swiss Food Research Network, Zürich, June 1st, 2023

White Lupin: a chance for sustainable, regional agriculture

- An European supplement to soybean
- 35 % and more protein content
- next best amino acid composition after soybean
- Legume family → N fixation
- frost tolerant summer crop
- Soil structure improvement,
- P mobilization
- drought tolerant
- Insect friendly flowers
- Increasing demand:
  - feed
  - food: vegetarian / vegan trend



Lupin in human nutrition

- lupin stays al dente after cooking
- Traditional mediterranean snack in salt brine
- good for bulgur-like dishes
- good for stuffed vegetables
- vegetarian bolognese
- processed meat substitutes
- roasted lupins as a coffee substitute
- Lupin flour + water as egg substitute

- contains all essential amino acids
- contains Fe
- anti-diabetic
- anti-hypertension properties
- satiating for a targeted weight loss
- low in phytoestrogens
- no purins
- No starch

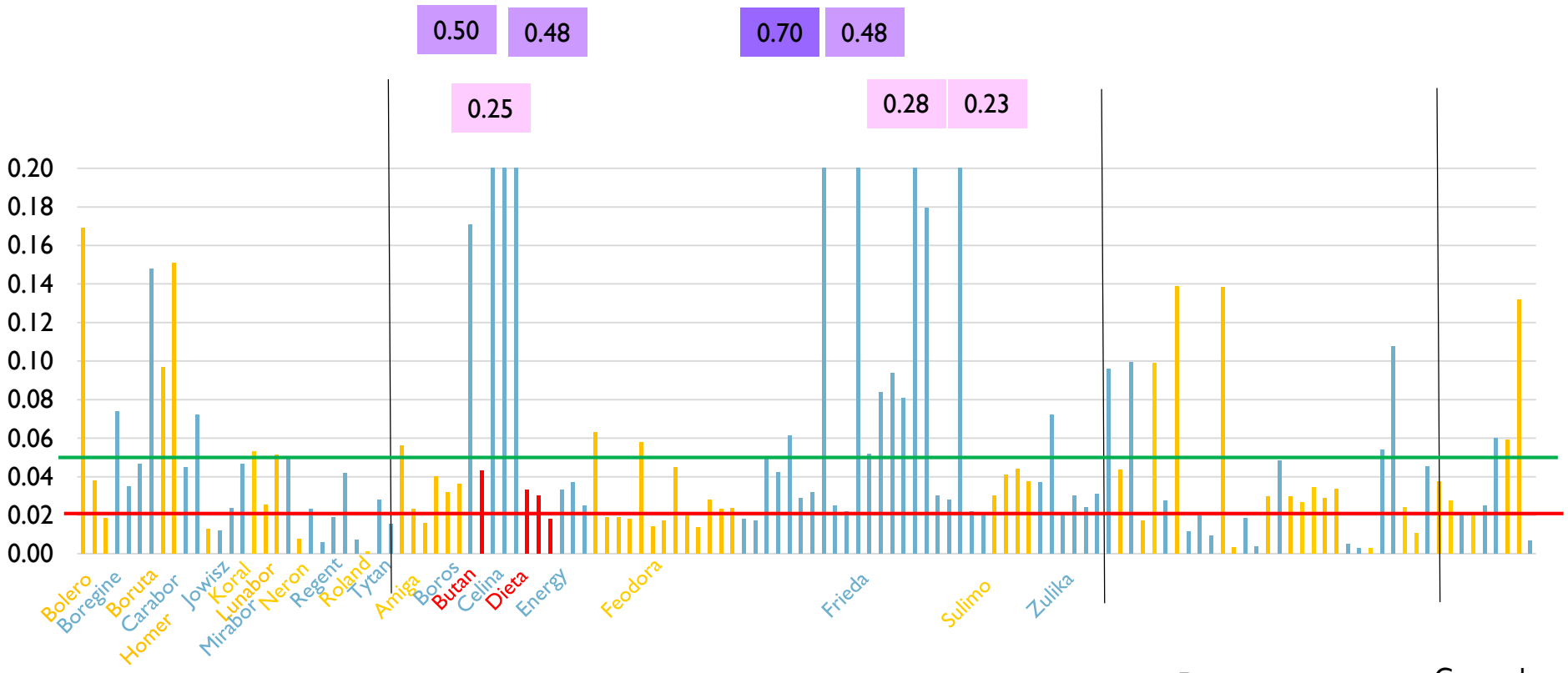
Anthracnose in white lupin

- main problem, total yield loss possible
- transmission: seed, rain splash
- under wet conditions > 25°C
- fungal agent: *Colletotrichum lupini*
- major reason for stagnating cultivation
- resistance breeding in Australia, Germany, Poland, Chile, Switzerland
- only quantitative resistance
- In Europe until now only 2 resistant varieties (Frieda, Celina (DE))

Alkaloids in white lupin

- > 150 lupin quinolizidin alkaloids (QA) known
- The sum of QA in lupins is relevant
- Traditional mediterranean cultivars/landraces contain 0.5 % - 8 % (5.000 - 80.000 mg/kg)
- Very bitter taste
- High concentration toxic for nervous, circulatory and digestive systems
- Recommended threshold for safe food is 0.02 % (for feed, 0.05 %)
- Water solulable
- Traditionally removed before consumption through soaking, rinsing and cooking
- Low alkaloid mutants predicted and found in Germany around 1930
- Since then, breeding of «sweet» cultivars (0.01 – 0.05 %) (100-500 mg/kg)
- Only 3-6 low alkaloid genes known
- Only two in present commercial cultivars («bottleneck» for breeding)
- No correlation of QA content with fungal resistance
- But bitter plants are more vigorous
- Many lupin batches had enhanced alkaloid contents

All 128 alkaloid analyses of lupins cultivated in Switzerland known to us, 2015-2022



recommended threshold for food

recommended threshold for feed

Narrow-leafed lupin

White lupin

Promising FiBL breeding lines

Crossed genetic resources

Samples from FiBL and gzpk trials and from farmers; analyzed in different labs

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	Objectives, workpackages	Lead by
1	Breeding of White Lupin for anthracnose resistance	FiBL
2	Breeding of White Lupin for low alkaloid content	FiBL
3	Developing a breeding programme for commercial white lupin cultivars	FiBL and gzpk
4	Cultivar trials	FiBL and gzpk
5	Identifying the market potential, networking	FiBL

Working groups


FiBL plant breeding group


Getreidezüchtung Peter Kunz (gzpk)


FiBL consumers and food group



Screening of genetic resources

every year since 2015:

- 100-200 new accessions
- single rows in mini-plots
- between infection rows of susceptible cultivar «Amiga»
- relative disease scoring
- 100-200 selected accessions from previous years
- challenge: up to 15% cross pollination possible
- → isolate selected plants from insects!

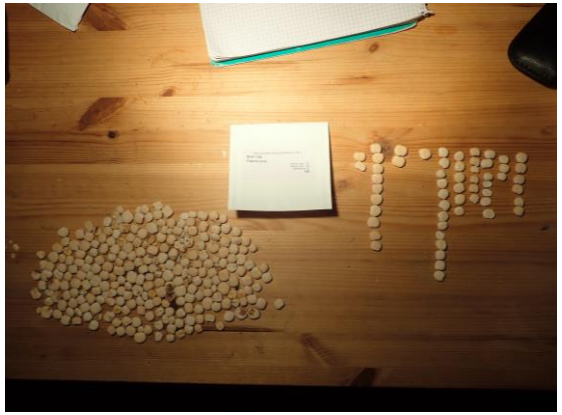
Amiga	Ethiopia	Amiga	Algeria	Amiga
(susceptible check)	(resistant)	(susc.check)	(resistant)	(susc. check)

Crossings and pedigrees

- sowing of crossing partners at staggered intervals
- crossings in the greenhouse
- F 1 – F 5: insect tunnel
- single plant selection starting mostly in F 4 (some sweet plants selected earlier)
- seed evaluation

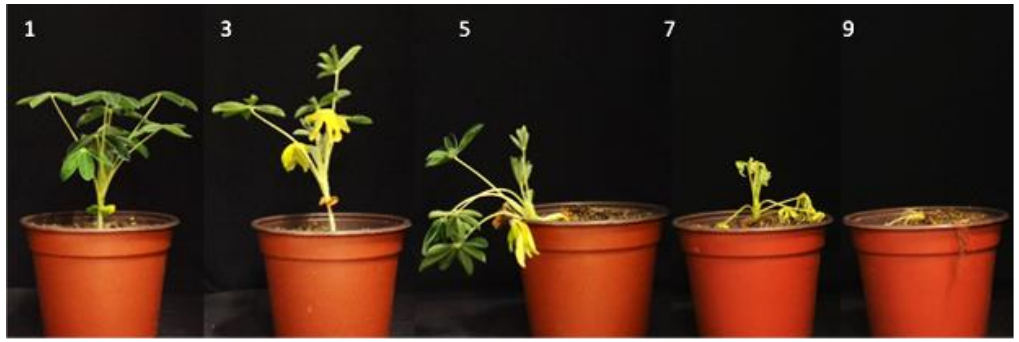




Disease scoring of F5/F6 after artificial inoculation

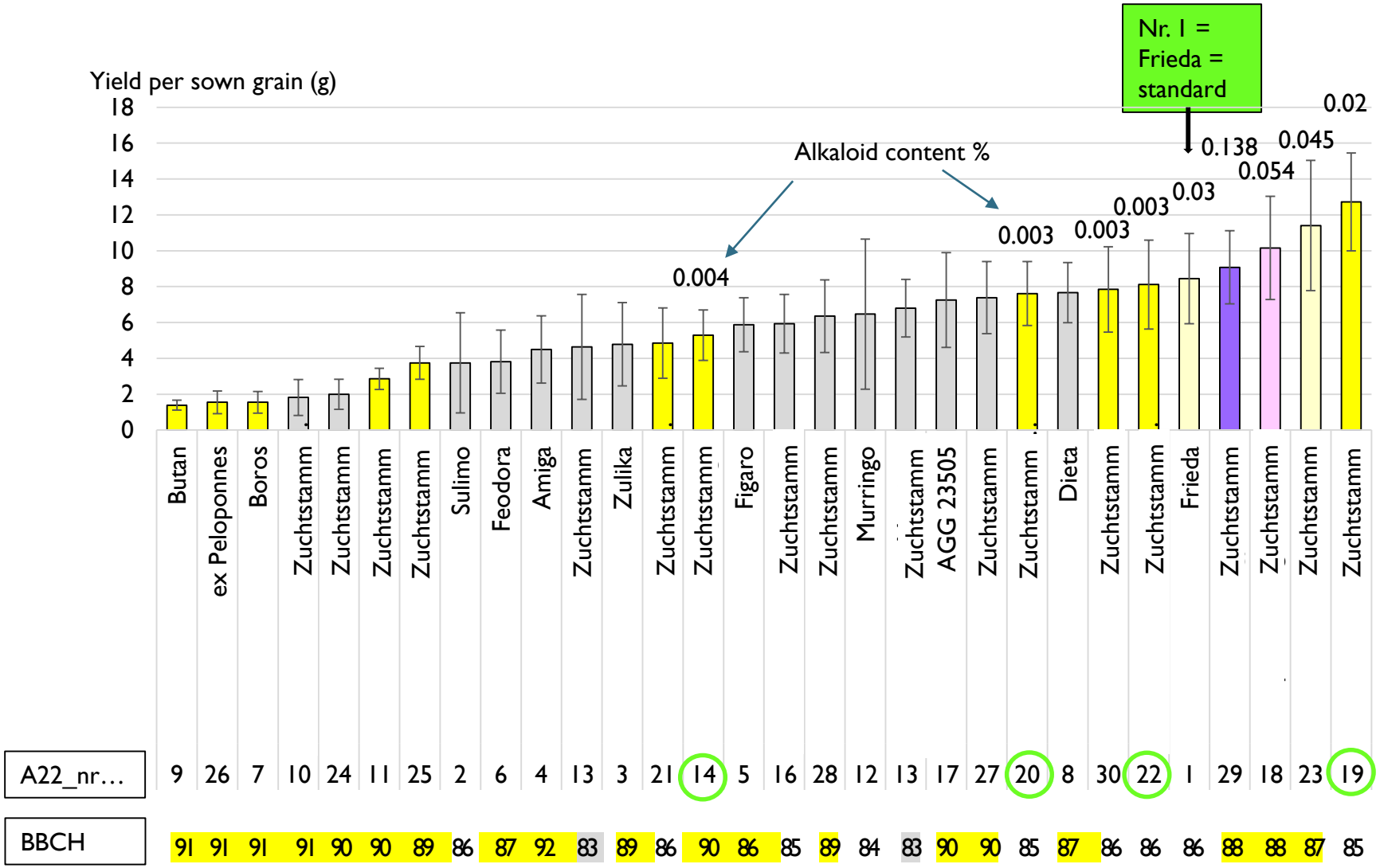
- controlled conditions, climate chamber
- 14-day-old plantlets
- stem wound inoculation with spore suspension
- repeated disease scoring over 14 days
- standardized area under disease progress curve



Alkemade et al. 2020

Single row ring trial with gzpk, advanced breeding lines

3 sites, 2 reps of single rows each



2023: 4 candidates from ring trial plus 2 sister lines = 6 candidates for first yield evaluation in miniplots

And if we perhaps succeed with registration of new cultivar(s)?

Then there should be a market demand for them!

That is the task in WP 5…

Many thanks for multiple support over 9 years!

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Supervision: Mariateresa Lazzaro, Pierre Hohmann, Monika Messmer

Breeding team!! Crops team! FiBL team…
Torsten Arncken

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Market potential and network

LUPINNO SUISSE Project

Ludivine Nicod, Ivraina Brändle, Claudia Meier, Ursula Kretzschmar, (FiBL)

8th Meeting of IG Proteins4Future – Swiss Food Research Network, Zürich, June 1st, 2023

Overview of the activities

Evaluation of the market potential for lupin in CH

Estimation of the production costs

Set-up of a network

Support to food processing trials

Identification of the needs & opportunities for lupin value chain

Market potential – consumer survey key takeaways

- Switzerland has not a «legume food culture»
  - 28% participants have already consumed lupin in the past (twice as many for soy beans)
- Most important perceived benefits of lupin: protein content, satiety properties, iron content, bee friendly crop, no fertilization needed, ressouce-efficient cultivation.
- > 50% of consumers evaluated lupin as an interesting alternative to soy
- Swiss origin is an important criteria for 62% of interviewees
- The less processed, the more participants were willing to buy a lupin product
  - Lupin bulgur was most popular followed by sweet lupin in jar and lupin spread.
  - Lupin meat alternatives and lupin cheese were significantly less popular.

Market potential – Stakeholders analysis

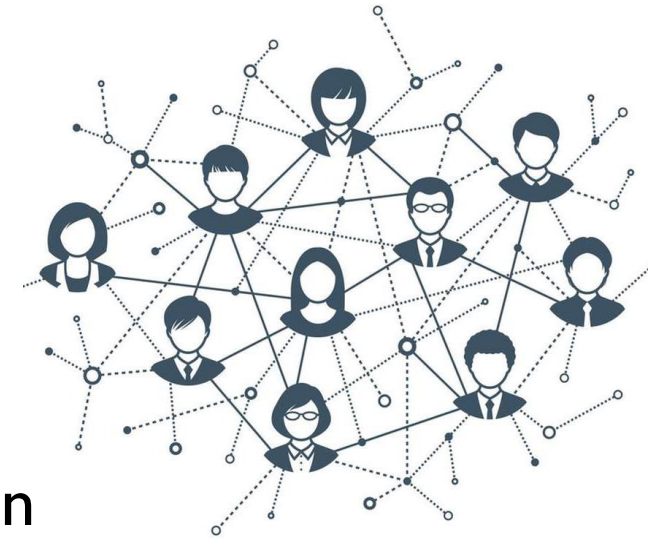
	Challenges	Opportunities
Production	Anthracnose Alkaloids	• Crop adapted to Swiss climate • Good for soil fertility • Drought tolerance due to deep root system
Product	Allergens	• High protein content • Interesting nutritional profile (low carbs, low fat)
Food processing	• Lack of cost efficient way to remove alcaloids • Lack of fast way to accurately measure the alcaloid content • Lack of 'primary processing' capacities • Lack of technologies to isolate proteins.	
Market	• Low awareness and demand for lupin • No value chain in place • Competition with other legumes	• Trend towards healthy, sustainable, and regional foods (plant-based protein sources from the region). • Poor image of soy.
Politics	• No border protection for legumes as food • Strong meat and milk lobby	

Workshop with lupin stakeholders

- 2 workshops organised with stakeholders from the lupin value chain
  - Jan. 2022 online (german speaking participants)
  - Feb. 2023 in Lausanne for actors in Romandie

- Objectives
  - Gather and connect all interested and active people in lupin value chain → build a lupin network
  - Exchange on experience with lupin along the value chain from farm to fork
  - Group discussion to identify the needs and opportunities in agriculture, post-harvest treatment and food processing

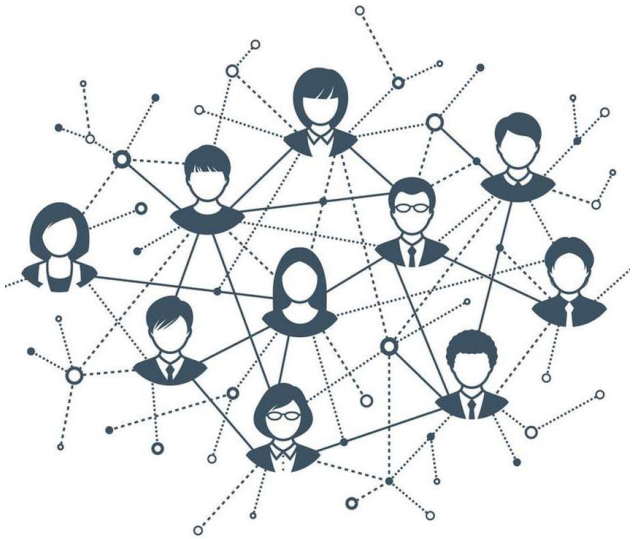
« Protein Power Network »



- Created in 2022
- Collaboration between Strickhof and FiBL
- Focus on grain legumes farming and food processing in Swizterland
- Active in German and French speaking parts of Switzerland

Objectives of the national network

- Connect all actors within the legumes value chains (researchers, producers, millers, food processors, consumers..)
- Build and spread knowledge in legumes farming
- Share experiences among network members
- Identify and communicate food processing opportunities (mills, food industries)
- Promote legumes to authorities and public
- Provide list of experts in different fields



Tools

- List of contacts
- “Teams” for members
- 4x network meetings/year
- Workshops
- Website

Website Swiss LegumeHub - introduction

- Information platform on growing and processing of legumes (organic and conventional)
- Publication of project results with a focus on Switzerland
- Information about upcoming events on the topic of legumes
- Networking of stakeholders via a contact list

Website Swiss LegumeHub - requirements

- Multilingual (GE, FR and IT tbc)
- Public website, accessible to anyone interested in the topic
- Interactive platform:
  - Users can upload content, information
  - Search function
- News, articles will be published on the website
- Agenda with key events, dates
- Blog, RSS feed

Preview: https://swiss.legumehub.eu/

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