Buckwheat research to diversify cropping systems – activities in Switzerland

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Introduction

Buckwheat (*Fagopyrum esculentum*):

- has the potential of **diversifying the landscape and widening crop rotations**
- is an **excellent bee crop**
- produces **seeds** that are interesting regarding the **increasing demand for gluten free** and **healthy food**
- has been **replaced by arable crops** with stable yield and a standardized agronomic management
- is difficult to breed due to **self-incompatibility** and **strong dependence to environmental conditions**

Objectives:

- Description of 20 buckwheat accessions in terms of **agronomically interesting traits** and **seed quality**
- Description of the **inter- and intra-specific variability** of quality traits
- Identification of suitable accessions for **cultivation in Switzerland** and implementation of a **breeding program**

Conclusions

- Buckwheat is mostly handled as populations. Our analysis of the phenotype and the seed quality suggest focusing on **individual plants that show the desired phenotype/seed quality** for buckwheat breeding. This would require further studies on heritability of certain traits and new breeding strategies.
- **Russian accessions** showed interesting agronomical traits but are sensitive to extreme weather conditions.
- Exploring the use of greenhouses for buckwheat breeding and research reveals **difficulties regarding pollination and phenotype**. However, seed quality seems to remain characteristic of accessions.

Phenotypic analysis

- Four small-plot trials with 12 accessions in four repetitions in the years 2014 and 2015; one trial under organic farming conditions
- Measured traits: soil cover, plant length at different growth stages, development of flower and maturity, grain yield and thousand kernel weight (tkw)

Tab. 1: Measured traits of selected accessions in the buckwheat trial in Münsingen under organic farming conditions (2015).

Accession		Soil cover 31 d.a.s. [%]			Start flowering [d.a.s.]			Plant heigth at fullflower [cm]			Plant heigth 61 d.a.s. [cm]			Yield at 87 % DM [kg/ha]			TKW [g]		
	origin		std	groups		std	groups		std	groups		std	groups		std	groups		std	groups
Dikul	RU	55.0	0.04	bcd	32.0	0.0	f	66.8	2.98	f	92.0	4.32	f	1222.5	372.59	abc	28.1	0.47	a
Dialog	RU	57.0	0.03	bcd	32.8	0.5	e	66.3	2.06	f	86.0	2.94	f	817.5	148.60	c	29.5	1.08	a
Devyatka	RU	58.0	0.07	bc	32.8	0.5	e	69.0	5.29	f	90.8	6.39	f	110.8	607.00	bc	28.9	0.63	a
Lileja	SLO	58.0	0.02	bc	34.8	0.5	d	100.5	6.35	cd	119.8	8.95	cd	1702.5	639.30	a	25.2	0.65	b
La Harpe	FR	55.0	0.04	bcd	32.0	0.0	bc	66.8	2.98	abc	92.0	4.32	ab	1222.5	372.59	abc	28.1	0.47	de
Bamby	AU	52.0	0.01	d	32.0	0.0	f	78.0	2.94	e	108.3	2.36	e	970.0	372.59	bc	20.7	0.82	d
Darja	SLO	61.0	0.06	b	38.0	0.0	c	113.0	3.55	a	128.8	7.50	ab	1507.5	649.48	ab	22.6	0.56	c
Billy	AU	69.0	0.03	a	40.0	0.0	a	111.3	4.34	ab	123.0	3.27	bcd	1112.5	372.59	bc	28.7	2.90	a
Orphé	FR	55.0	0.03	cd	33.0	0.0	e	95.0	4.08	d	115.8	4.34	de	1185.0	126.80	abc	18.5	0.39	e
Mean		**58.0**			**35.0**			**91.8**			**112.4**			**1219.3**			**24.2**		

LSD Test alpha 0.05, groups = different letters indicate significant differences between accessions, d.a.s. = Days after sowing

- Billy and Darja covered soil faster than Bamby (Tab. 1), Russian accessions remained shorter than others
- TKW varied between 18.5 (Orphé) and 29.5 g (Dialog), Grain yield between 818 (Dialog) and 1’700 kg/ha (Lileja)
- No mechanical control of weeds led to high weed infestations and high variation in grain yield.

Seed quality

- 20 accessions grown in the field in two consecutive years; subset of six accessions grown in the greenhouse.
- Whole (hulled) seeds of 20 individual plants per accession were milled and content of starch, total soluble protein and polyphenol compounds as well as the antioxidant activity were measured

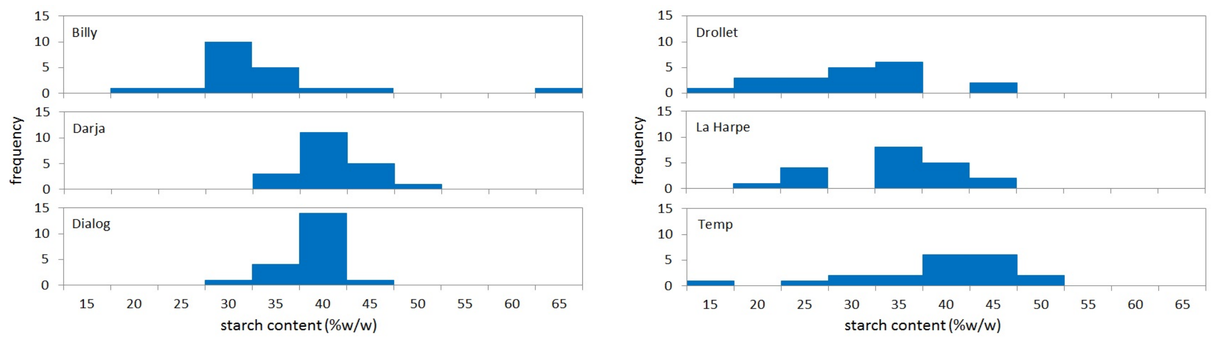

Fig. 1. Starch content of a subset of six accessions grown in the field in 2014. Low content of starch presumably is due to unfavorable environmental conditions during the growth period in 2014.

Preliminary results indicate:

- High variability within the accessions for all measured traits in field and greenhouse, therefore:
  - Challenging to clearly distinguish among accessions
  - Mostly no significant difference between growth in greenhouse and field detectable

The relevance of this finding for further studies (potential breeding program) is currently assessed.

Outlook

- **Degustation trial** (flour and whole grain) of the six most promising accessions.
- Testing the most promising accessions for **dehulling** with existing equipment.
- **Genetic analysis**: genotyping-by-sequencing approach on population level to genetically describe the accessions and associate the phenotypic data to its genetics.

Partners