New developments in testing for sustainability of varieties

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Testing varieties for sustainability in the Austrian VsCU-system

What does a sustainable variety stand for:

- Resilience against abiotic stressors
- Low susceptibility (diseases, pests) and high competitiveness (weeds) to biotic stressors
- High use efficiency of nutrients available (incl. water)
- AND good yield performance with satisfying processing quality

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Resilience against abiotic stressors

- **Winter hardiness:** Frost, frost dryness, long lasting snow coverage
  Crop stand after winter, frost damage, portion of leaves / plants lost by frost

- **Rapidness of youth growth**: Low temperatures in spring; cool, wet soils
  -> Above ground green mass,
  -> Percentage soil coverage,
  -> Canopy closure between rows

  Weed competitiveness
  Earlier ground shading
  Larger leaf area for photosynthesis

Maize, millet, sunflower, oil pumpkin, soybean, faba bean, pea

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Resilience against abiotic stressors:

- **Drought stress (water efficiency):**
  - a) Trials with and without irrigation (at one site in soybean and winter wheat, each)

    -> Yield level and yield reduction in non-irrigated plots

    Concerns: Doubling of trial plots

Non irrigate WP-SOJA-B00KLI-NWe-2024 Irrigated WP-SOJA-B00-NWe-2024 00_Varieties

C non irrigated	28	26	29	27	25	30	35	33	36	31	34	32	22	24	23	20	19	21	9	12	8	11	7	10	16	13	17	14	18	15	2	5	1	4	6	3
C irrigated	28	26	29	27	25	30	35	33	36	31	34	32	22	24	23	20	19	21	9	12	8	11	7	10	16	13	17	14	18	15	2	5	1	4	6	3
A irrigated	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
A non irrigated	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36

25	7	13	19	31	1	11	5	23	17	35	29	6	30	18	24	12	36	8	20	32	2	14	26	15	27	9	33	3	21	4	34	16	10	22	28	D non irrigated
25	7	13	19	31	1	11	5	23	17	35	29	6	30	18	24	12	36	8	20	32	2	14	26	15	27	9	33	3	21	4	34	16	10	22	28	D irrigated
16	4	22	34	28	10	36	12	6	18	30	24	11	17	35	5	29	23	25	19	7	1	13	31	3	33	15	21	27	9	32	26	20	14	8	2	B irrigated
16	4	22	34	28	10	36	12	6	18	30	24	11	17	35	5	29	23	25	19	7	1	13	31	3	33	15	21	27	9	32	26	20	14	8	2	B non irrigated

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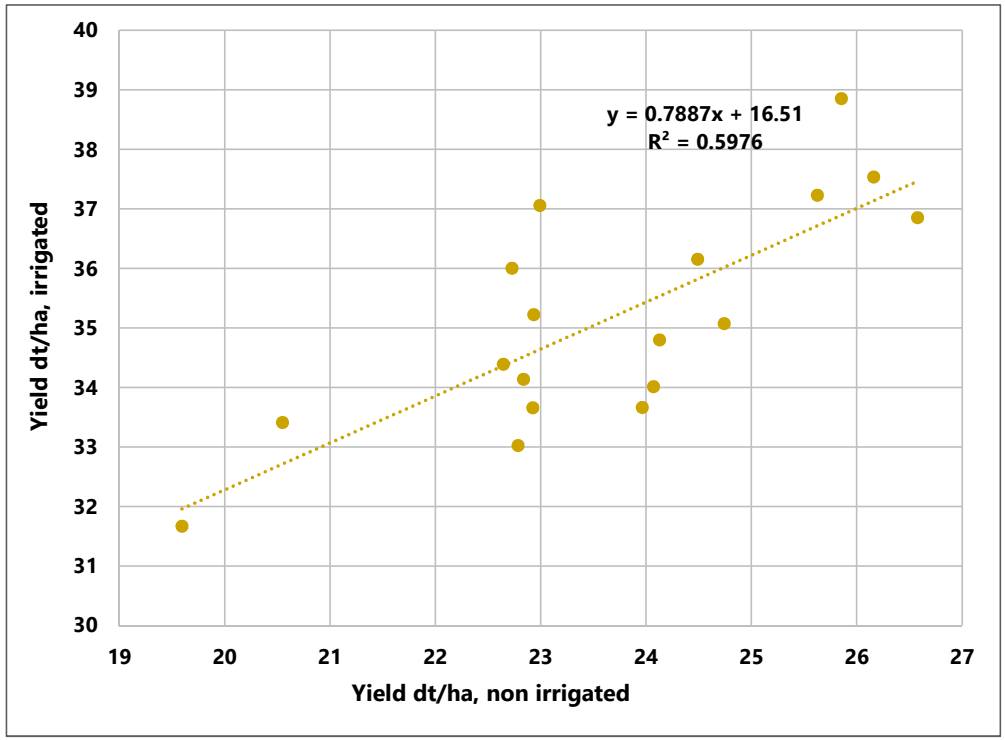

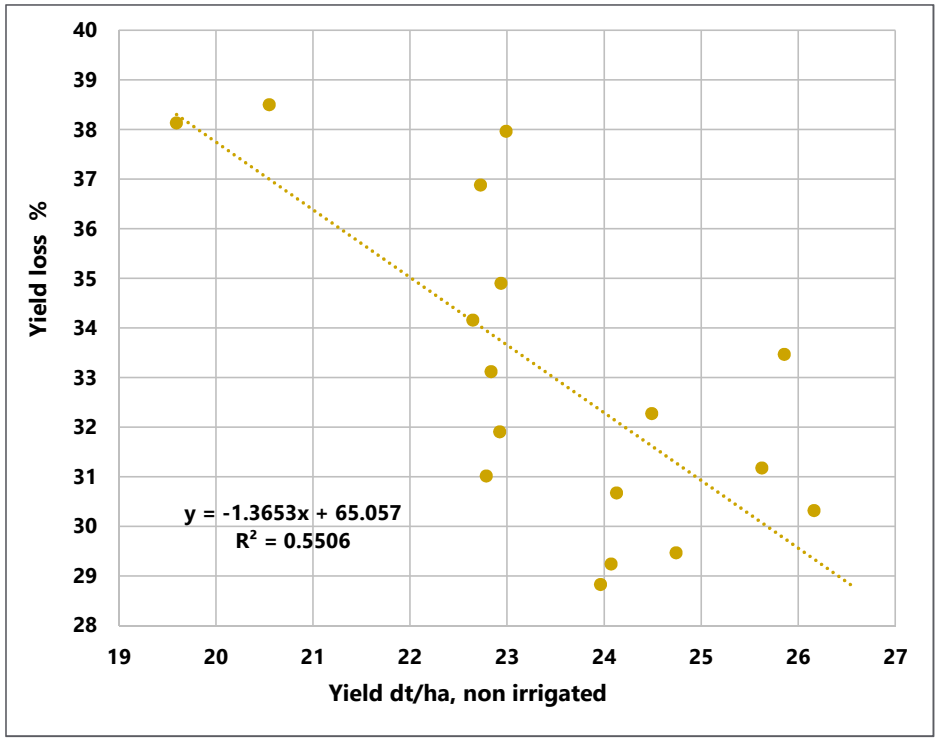

Soybean varieties 00, yield reaction to irrigation, VCU-data, Austria, Fuchsenbigl, 2021-2023

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Resilience against abiotic stressors:

- **Drought stress (water efficiency):**

b) Trial with drought stress and irrigation below demand, e.g: two instead of four supplies (one site in soybean):
-> Yield performance under reduced irrgation

c) Monitoring of environmental conditions (sensors for soil data, two sites in maize, one in wheat):
-> Yield performance with improved data for interpretation and explanation of variety specific reaction
Concerns: Positioning and movement of soil sensor devices

d) Classification of trial sites for drought stress (in each year for each species):
Best based on soil data, weather data and
supported by growth indices (drone data)

Austrian VCU trials – focus stress reactions, management strategies

- Different production conditions, soil types and climatic conditions
- Detailed phenotypization according to extended VCU protocols (i.e., incl. evaluation of tuberization)
- Drone flights and detailed monitoring of environmental data

Trial	ZIP	Supervision	Production	Soil	Climate	Drone flights	Environmental sensors	Evaluation of tuberisation	Irrigation
Fuchsenbigl irrigated	2286	AGES	Conventional	Black	Continental	X	X		X
Fuchsenbigl non-irrigated	2286	AGES	Conventional	Black	Continental	X	X	X	
Großnondorf	2042	AGES	Conventional	Black	Continental	X	X	X	
Sierndorf	2011	NÖS	Organic	Black	Continental	X	X		
Schwarzenau	3900	NÖS	organic	Brown	Marine to continental		X		

Major challenges

- Growth conditions in 2022 and 2023 differed widely
- Data gaps may occur

- Observations in a nutshell:
  - Differences between trials sites with trends in variety reactions to stress conditions
  - Environmental data used to establish recommendations for management strategies
  - Further evaluation of using drone data use is necessary

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Low suceptibility to biotic stressors: Cereals

	Mildew	Ergot	Yellow rust	Stem rust	Tan spot (DTR)	Ear fusariosis	Common bunt	Septoria tritici
Winter rye	natural	artificial Hag, Sch, 4x						
Winter triticale	natural		artificial Gra			Provocation		
Winter wheat			artificial Gra	artificial, 3-years	natural, rotation	Provocation	artificial	natural
Winter durum wheat			artificial Gra	artificial, 3-years	natural, rotation	Provocation		natural
Winter spelt			artificial Gra	artificial, 3-years			artificial	natural
Spring barley	natural							
Spring wheat			artificial Gra	artificial, 3-years	natural, rotation	Provocation		natural
Oat	natural							

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Maize: Ear fusariosis

Sampling

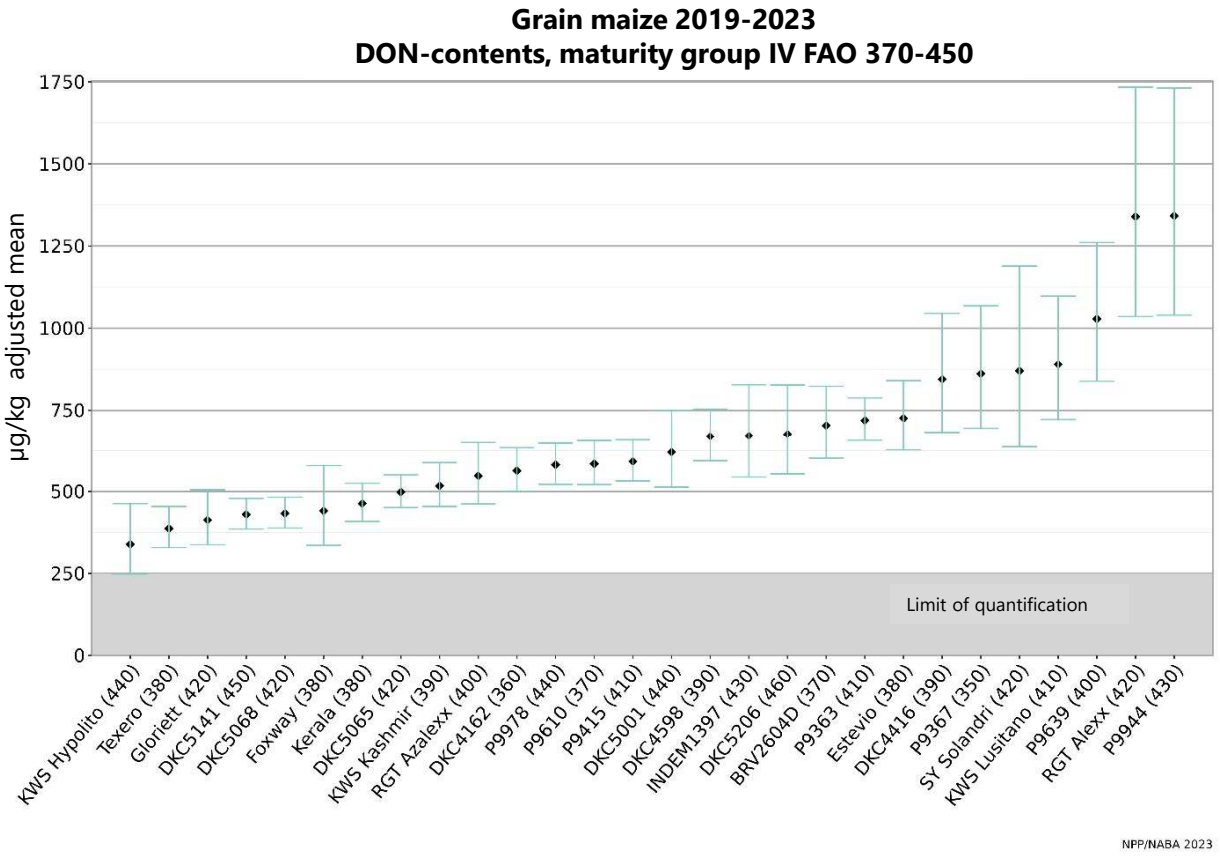
33 trial sites of varieties in 2nd year of VsCU:
850 samples / year,

Assessment:

- Visual recordings of natural ear infestation
- analyses of mycotoxin contents of
  DON, ZEA, FUM in kernels,
  => score on the 1-9 scale

Registration:

score 8 or 9 -> rejection,
score 7 -> more results or regional interpretation
scores from 3 to 7 on 1-9 scale
in the descriptive list of varieties



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N-use efficiency - protein yield in grains

Crop species	Sortiment	Varieties inlcuded	Scores (1-9) 1=very low; 9=very high		Intervarietal variation dt/ha	
Cereals (2010-2023)			Lowest-highest	Median	Lowest-highest	Mean
Winter wheat	Dry region	91	1 - 9	6	7,6 – 10,3	9,37
Winter wheat	Humid region	87	2 - 9	6	9,1 – 11,5	10,18
Winter barley		105	1 - 8	5	8,0 – 10,1	9,18
Winter triticale		35	2 - 8	5	6,9 – 9,1	8,25
Winter rye		24	3 - 8	5	5,7 - 7,1	6,3
Spring barley		76	2 - 8	5	5,5 – 7,0	6,40
Maize (2018-2023)						
Maturity Group I	≤ FAO 250	25	3 - 6	4	9,5 – 11,4	10,45
Maturity Group II	FAO >250 - 300	38	3 - 8	4	9,6 – 12,4	10,38
Maturity Group III	FAO >300 - 350	26	4 - 7	5	10,2 – 11,6	10,70
Maturity Group IV	FAO >350 - 450	36	3 - 8	6	9,8 – 11,9	10,98

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Conclusions

- Before expanding the trial network, it would be more efficient to invest in better availability of environmental data and information on the condition of the crop at the existing trial sites.
- Sustainability of varieties usually manifests itself in varying degrees in many individual characteristics.
- An integrative approach for an overall assessment of the sustainability of a variety seems worth considering.
- Sustainability criteria are becoming more important in the decision process for or against the registration of varieties than in the past.


Thank you for your attention

Austrian Agency for Health
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