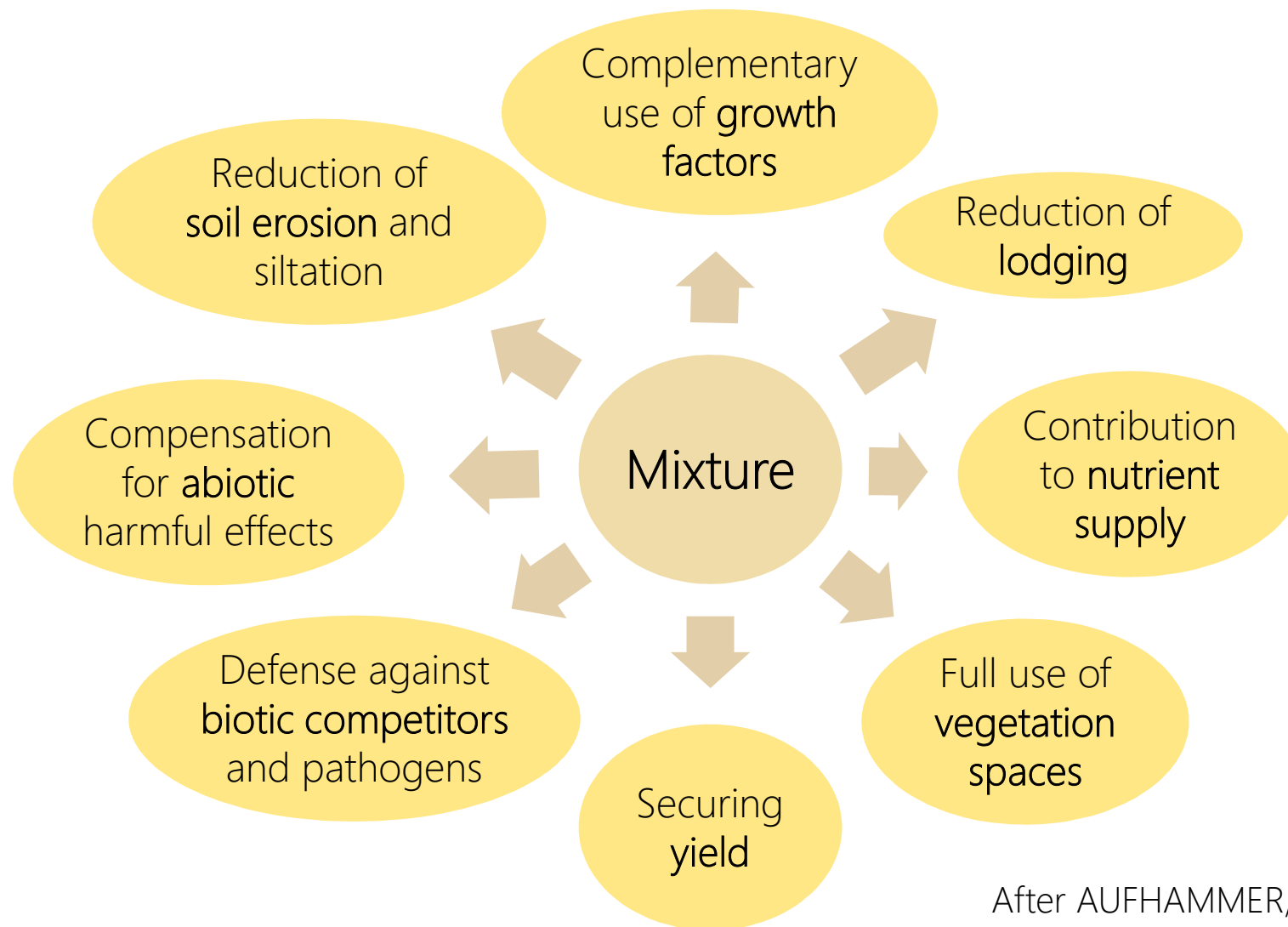# Variety mixtures and OHM in the Austrian INVITE wheat trials

17th EU-VCU EXPERTS' GROUP MEETING
May 13th to 15th 2024 – Korsør, Denmark
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AGES, Institute for Sustainable Plant Production

Function of mixed stands
Mixtures of species and varieties

AGES

Complementary use of **growth factors**

Reduction of **soil erosion** and siltation

Reduction of **lodging**

Compensation for **abiotic** harmful effects

Mixture

Contribution to **nutrient supply**

Defense against **biotic competitors and pathogens**

Full use of **vegetation spaces**

Securing **yield**

After AUFHAMMER, 1999

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Introduction to variety mixtures and OHM
Legal situation

☛ § 25 ff Austrian seed law 1997: Seed mixtures are permitted if:

- Seeds from species listed in the species list

- Seeds were approved before mixing

- the growth is intended for fodder use and green manure or, in the case of cereals and legumes, also for grain use

☛ Austrian seed regulation 2006: Mixtures of different varieties (e.g. wheat) must be registered at the responsible licensing authority

☛ REGULATION (EU) 2018/848 on organic production:

- After a notification, the organic heterogenous material (OHM) can be produced and sold.

- This regulation came into effect in January, 2022.

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Material in the trials
Description of the varieties, mixtures and OHM

Variety/Mixture/OHM	Typ	Registration	Quality classification*
Aurelius	Variety	AT, HU, SK	BQG 7
Bernstein	Variety	AT, CZ, DE, LU, NO	BQG 8
Aurelius + Bernstein, 1:1	Mixture	-	-
Baretta	Variety	CH	Top
Montalbano	Variety	CH	Top
Baretta + Montalbano, 1:1	Mixture	-	-
Pizza	Variety	CH	Top
Wiwa	Variety	CH, CZ	Top
Wiwa + Pizza, 1:1	Mixture	-	-
Brandex Population	Population	(DE)**	-
Mv Elit CCP	Population	(HU)**	-
Solibam	Population	(IT)**	-

* Quality classification (Austrian descriptive list of varieties 2024 or Swiss Granum 2021)
** Notification

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Variety mixtures

Aurelius and Bernstein Baretta and Montalbano Pizza and Wiwa

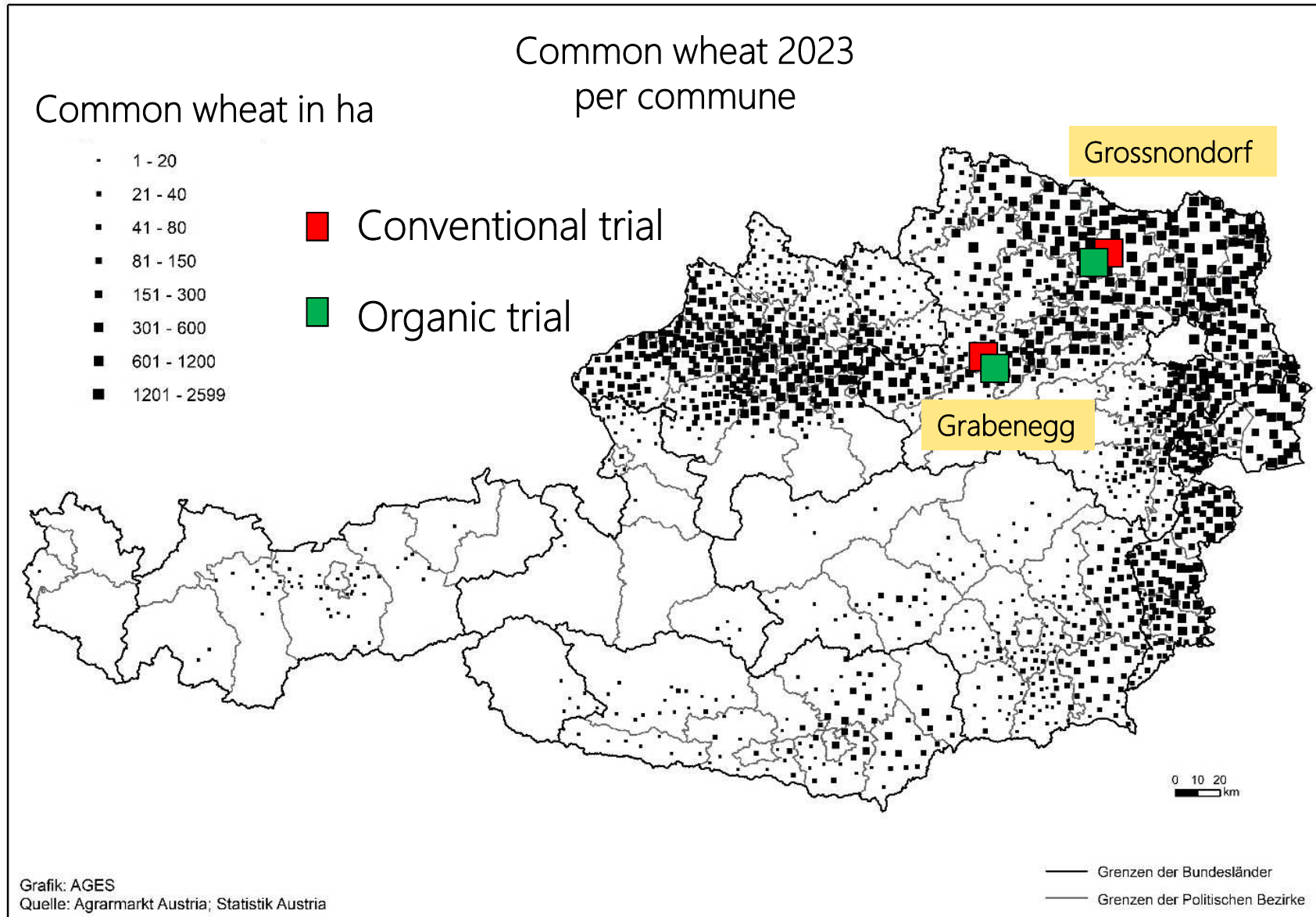

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Organic Heterogenous Material

Solibam

MV Elit CCP

Brandex Population

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Winter wheat mixture trials 2021-2022

Common wheat 2023
per commune

Common wheat in ha

- 1 - 20
- 21 - 40
- 41 - 80
- 81 - 150
- 151 - 300
- 301 - 600
- 601 - 1200
- 1201 - 2599

🟥 Conventional trial

🟩 Organic trial

Grossnondorf

Grabenegg

0 10 20
km

Grafik: AGES
Quelle: Agrarmarkt Austria; Statistik Austria

Grenzen der Bundesländer
Grenzen der Politischen Bezirke

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Yield difference (dt/ha) mixture to pure stand
8 wheat trials in Austria 2021-2022

AGES

Yield difference (dt/ha) variety mixture to pure stand

Organic trials   Conventional trials   Mean

Mean   Mean

■ Aurelius + Bernstein   ■ Baretta + Montalbano   ■ Wiwa + Pizza

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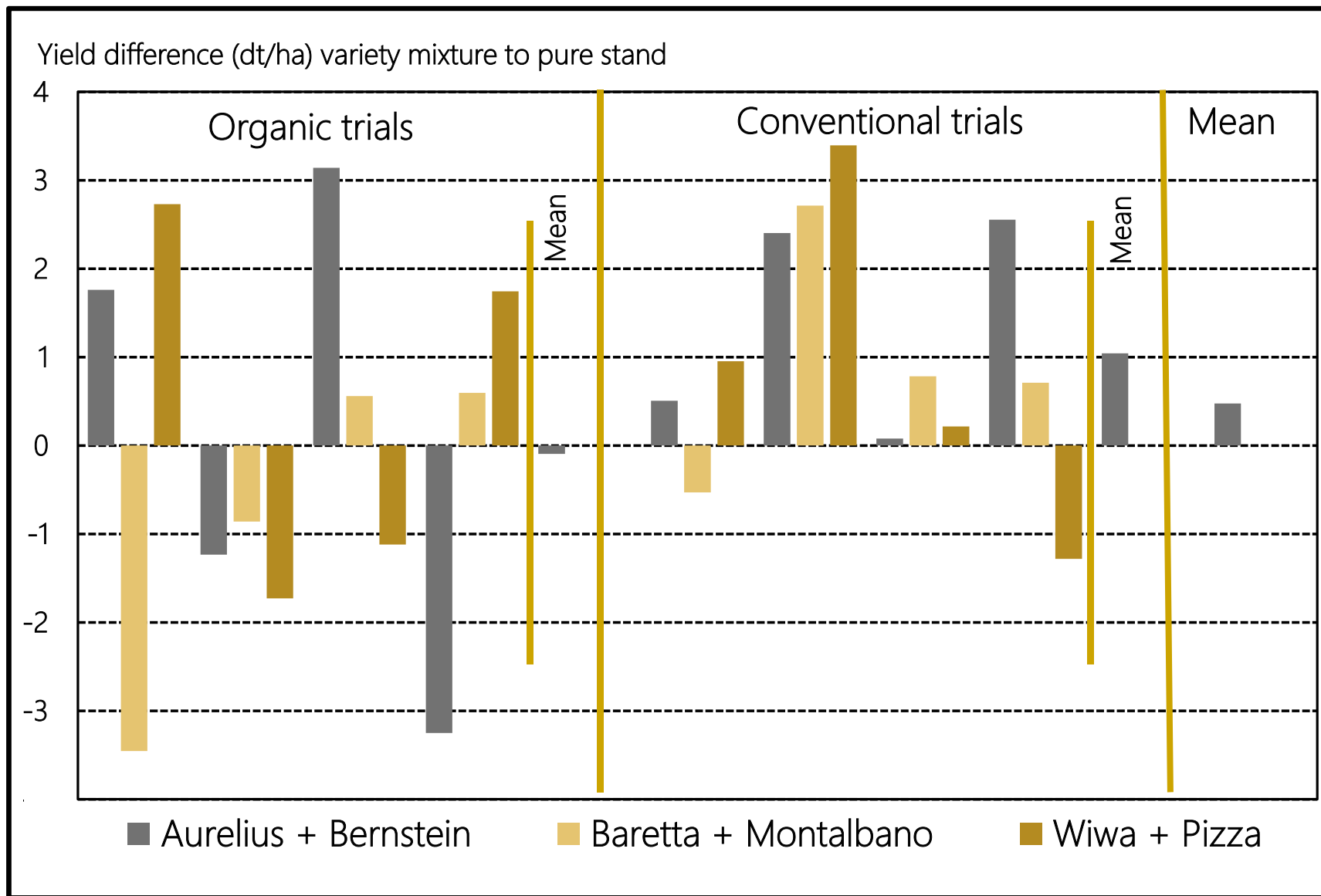
Wheat: Yield and yield parameters

Comparison of mixtures, means of varieties and OHM (N=8)

Mixture/Mean/OHM	KOEQ	TKGN	BEST	KZAE	KZM2	AEGW	RPSQ
Aurelius + Bernstein, 1:1	94,9	45,4	532	40,5	20.995	1,94	11,7
Aurelius/Bernstein-Mean	94,2	45,7	521	41,0	20.707	1,89	11,3
Difference 1	+0,7	-0,3	+11	-0,4	+288	+0,05	+0,4
Baretta + Montalbano, 1:1	86,9	45,4	507	38,8	19.199	1,71	11,4
Baretta/Montalbano-Mean	86,8	45,2	502	39,5	19.323	1,76	11,3
Difference 2	+0,1	+0,2	+5	-0,7	-123	-0,05	+0,1
Wiwa + Pizza, 1:1	79,5	42,1	531	33,9	17.365	1,46	10,9
Wiwa/Pizza-Mean	78,9	42,9	547	33,0	17.662	1,46	10,6
Difference 3	+0,6	-0,8	-16	+0,9	-297	+0,01	+0,2
Varieties-Mean	86,6	44,6	523	37,8	19.230	1,70	11,1
Brandex Population	88,7	46,7	512	38,0	19.038	1,83	11,5
Mv Elit CCP	83,8	44,5	525	36,6	18.857	1,62	10,8
Solibam	69,0	52,1	554	24,8	13.279	1,46	9,8

In post-hoc-test: no signifikant difference between mean of the components and the mixture (α = 0,05)
KOEQ = yield (dt/ha), TKGN = thousand kernel weight (g 86% DM), BEST = ears per square meter, KZAE = numbers of kernels per ear, KZM2 = number of kernels per square meter, ear weight (g 86% DM), RPSQ = protein yield (dt/ha)

Wheat: diseases and leaf ripening

Comparison of mixtures, means of varieties and OHM (N=2-10)

Mixture/Mean/OHM	AEFU	BLAR	BRST	GRST	DTR	LAGR	MEHL	SEPB
Aurelius + Bernstein, 1:1	1,8	6,1	4,3	1,1	5,0	1,1	3,3	2,0
Aurelius/Bernstein-Mean	1,8	6,1	4,0	1,2	5,3	1,1	2,7	2,0
Difference 1	+0,1	-0,1	+0,3	-0,1	-0,3	±0,0	+0,6	±0,0
Baretta + Montalbano, 1:1	1,7	5,7	3,2	1,0	5,7	1,0	1,8	2,5
Baretta/Montalbano-Mean	1,3	5,5	2,7	1,1	5,8	1,1	1,6	2,3
Difference 2	+0,3	+0,2	+0,4	-0,1	-0,2	-0,1	+0,2	+0,3
Wiwa + Pizza, 1:1	1,3	5,2	5,0	1,2	5,7	2,0	2,3	3,0
Wiwa/Pizza-Mean	1,1	5,4	4,7	1,1	5,3	1,7	2,5	3,2
Difference 3	+0,3	-0,2	+0,3	+0,1	+0,3	+0,2	-0,2	-0,2
Varieties-Mean	1,4	5,7	3,8	1,1	5,5	1,3	2,3	2,5
Brandex Population	1,5	5,7	4,8	1,0	5,8	2,5	1,9	2,5
Mv Elit CCP	3,7	8,2	3,2	1,8	7,8	1,4	1,6	4,8
Solibam	1,2	7,5	3,8	1,0	4,5	5,8	3,8	3,7

In post-hoc-test: no signifikant difference between mean of the components and the mixture (α = 0,05)
Each parameter in score 1-9: AEFU = fusarium ear blight, BLAR = leaf ripening, BRST = brown rust, GRST = yellow rust, DTR = tan spot, LAGR = lodging, MEHL = mildew, SEPB = Septoria nodorum-leaf blotch

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Wheat: indirect quality parameters

Comparison of mixtures, means of varieties and OHM (N=8)

Mixture/Mean/OHM	HLGW	RPRT	GLUT	SEDW	FZAL	MA55	KHTE
Aurelius + Bernstein, 1:1	82,7	14,2	28,1	60,3	390	71,5	55,1
Aurelius/Bernstein-Mean	82,8	13,9	28,1	61,6	382	69,5	54,8
Difference 1	-0,1	+0,4	±0,0	-1,3	+7	+2,0	+0,4
Baretta + Montalbano, 1:1	79,4	15,2	30,0	61,8	370	69,1	57,8
Baretta/Montalbano-Mean	79,7	15,1	30,1	61,9	385	68,5	57,8
Difference 2	-0,3	+0,1	-0,1	-0,2	-15	+0,6	-0,1
Wiwa + Pizza, 1:1	82,8	15,8	33,1	64,4	371	71,3	56,6
Wiwa/Pizza-Mean	82,9	15,6	32,7	64,4	362	70,2	56,5
Difference 3	-0,1	+0,2	+0,4	±0,0	+9	+1,1	+0,1
Varieties-Mean	81,8	14,8	30,3	62,6	377	69,4	56,4
Brandex Population	81,0	15,0	30,9	59,6	345	72,2	56,9
Mv Elit CCP	79,3	14,9	32,2	50,8	355	64,5	56,4
Solibam	80,5	16,4	28,4	29,6	284	63,9	38,8

In post-hoc-test: no signifikant difference between mean of the components and the mixture ($\alpha = 0,05$)
HLGW = hectoliter weight (kg), RPRT = protein content (%), GLUT = wet gluten content (%),
SEDW = sedimentation value (ml), FZAL = falling number (s), MA55 = flour yield (%), KHTE = grain hardness

Wheat: dough and baking parameters

Comparison of mixtures, means of varieties and OHM (N=8)

Mixture/Mean/OHM	WAUF	TSTA	QUZA	WAUE	B135	M135	TEEN	VOLU	BQG
Aurelius + Bernstein, 1:1	59,9	9,6	101,4	54,3	178	628	147	471	8
Aurelius/Bernstein-Mean	59,3	8,8	93,7	54,1	177	662	155	471	7/8
Difference 1	+0,6	+0,8	+7,7	+0,2	±0	-34	-8	±0	
Baretta + Montalbano, 1:1	62,0	7,9	91,9	56,4	180	567	136	458	7
Baretta/Montalbano-Mean	61,4	8,6	94,9	56,0	176	563	133	459	8/6
Difference 2	+0,6	-0,7	-3,1	+0,3	+3	+3	+3	-1	
Wiwa + Pizza, 1:1	61,0	7,2	83,5	55,7	191	577	145	506	8
Wiwa/Pizza-Mean	61,4	7,6	85,7	55,7	193	568	147	514	8/9
Difference 3	-0,3	-0,3	-2,2	±0,0	-2	+9	-2	-8	
Varieties-Mean	60,7	8,3	91,4	55,3	182	598	145	481	
Brandex Population	61,5	5,8	72,0	55,2	191	370	99	475	7
Mv Elit CCP	66,6	5,5	74,5	61,2	173	285	71	456	5
Solibam	59,2	2,1	35,6	53,9	219	125	40	396	2

In post-hoc-test: no signifikant difference between mean of the components and the mixture (α = 0,05)

Farinograph: WAUF = water absorption (%), TSTA = dough stability (min), QUZA = quality number (mm)

Extensograph: WAUE = water absorption (%), after 135 min rest time: B135 = dough extensibility (mm), M135 = resistance (max) to extension (EU), TEEN = dough energy (cm²)

Baking test and baking group: VOLU = baking volume (ml/100g) BQG = baking quality group (Austrian classification)

Yield stability (variance of the yield variations)

8 wheat trials 2021-2022 (after Shukla 1972)

Variety/Mixture/OHM	Organic	Conventional	Total
Montalbano	-0,32	0,63	0,28
Pizza	2,16	4,08	2,62
Baretta	7,57	1,58	3,78
Wiwa	-0,57	12,07	5,70
Baretta + Montalbano, 1:1	9,15	1,19	5,75
Wiwa + Pizza, 1:1	6,08	13,03	8,82
Aurelius	13,62	7,54	9,95
Aurelius + Bernstein, 1:1	21,83	2,40	11,43
Solibam	11,65	18,25	13,33
Brandex Population	14,38	3,61	13,41
Mv Elit CCP	29,65	11,63	23,15
Bernstein	48,00	3,37	24,80

Lower values mean higher yield stability.

Conclusion on mixtures and OHM
Low effects of mixtures and high differences of OHM

- 8 wheat trials in Austria 2021-2022 of the INVITE-project
- No significant differences of mixtures and mean of pure stands:
  - Yield and yield parameters: only yield tends to be higher of mixtures
  - Diseases: only fusarium ear blight and brown rust tends to be lower
  - Quality: the following parameters tend to be higher of mixtures: protein content and flour yield,
  - Yield stability: two mixtures were worse than the components
- OHM:
  - Brandex Pop. and Mv Elit CCP are comparable to the varieties
  - Solibam: Seems not to be well adopted to the Austrian climate.
- General: Mixtures and OHM can be tested and described like varieties.

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Thank you

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