Vastediversiteetti on asian ytimessä!

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LUONNONVARAKESKUS

Ilmastokestävyys ja resilienssi

- ✓ Kasvien **ilmastokestävyys** on tärkeä asia, koska ilmastonmuutos voimistaa sään vaihtelua ja ilmaston ääri-ilmiöitä.
  - ✓ Ilmaston äkilliset ja voimakkaat vaihtelut hankaloittavat viljelykasvien selviämistä ja kelvollisen sadon tuottamista.
  - ✓ **Ilmastokestävyys** onkin varautumista säiden ennakoimattomuuteen sekä lisääntyvään vaihteluun ja äärevyyteen.
    - ✓ <u>Yksi lajike ei pysty vastaamaan erilaisiin säihin</u> vaan lajikkeistoa pitää kehittää monimuotoisempaan suuntaan.
  - ✓ Lajikkeiston menestyminen ilmaston muutoksissa vaikuttaa ruokaturvaan sekä huoltovarmuuteen

- ✓ **Resilienssi**llä tarkoitetaan sopeutumis-, sieto- ja muutoskykyä vastoinkäymisille ja erilaisille stressitekijöille
  - ✓ Kykyä sietää odottamattomia muutoksia ja palautua tai muuttua niin, että toimintakyky uudessa tilanteessa säilyy.

Clustering of Cultivars
- Based on Yield Responses to Weather

Vehnän erilaisia lajikeryhmiä, jotka sietävät vaihtelevia säitä. Kuva: iStockphoto Käyttö vain LUT-yliopiston vilja-tutkimusta käsittelevässä yhteydessä lisenssioikeuksie

Monipuolinen lajikevalinta voi lisätä viljelyn sopeutumiskykyä, koska lajikkeet reagoivat eri tavoilla sääilmiöihin. Nykyhetkellä keskimäärin isotuottoiset on suosituimpia.

H. Kahiluoto et al. / Global Environmental Change 25 (2014) 186–193

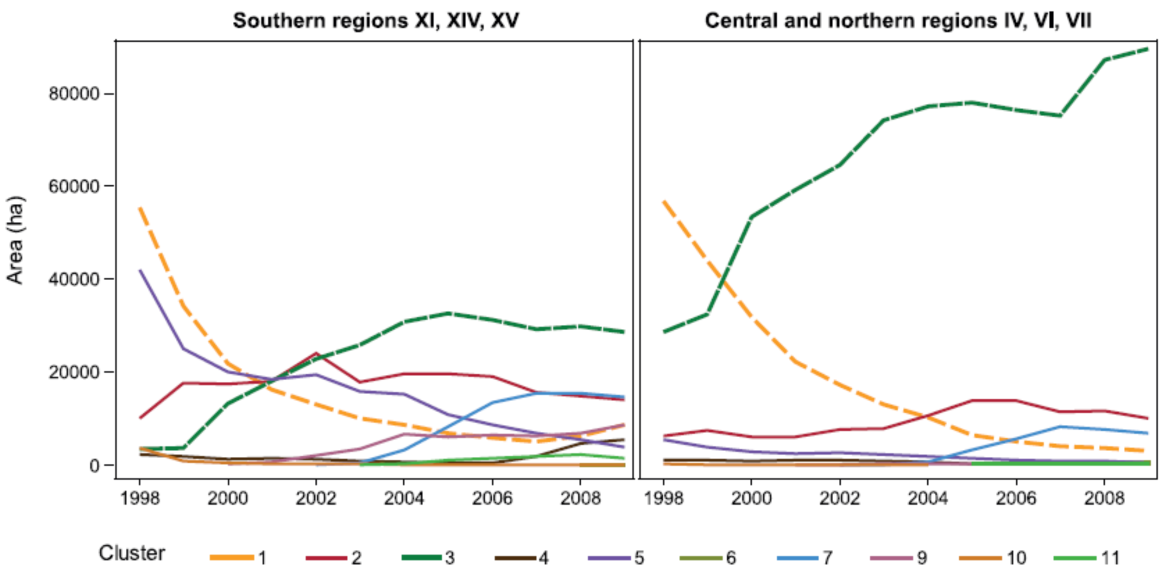

Fig. 3. Development of the cultivation area of the barley cultivar response clusters (1998–2009) in the Southern regions (left) and in the Central and Northern regions (right) of Finland. Cluster 3 represents cultivars, the grain yield of which is clearly reduced by drought and benefits from relatively early sowing. Cluster 1 represents cultivars with a stable but only moderate yield.

✓ Päivitetään uusi vuosikymmen mukaan (1980-2009 -> 1980-2018).

1) Onko tilanne muuttunut uusien lajikkeiden myötä?
2) Minkälaisia klusterit ovat ilmastomuuttujien suhteen?
3) Mitkä lajikkeet esiintyy milläkin klusterilla?

Comparison of diversity indices for period 1998-2009 from several areas in Finland. Type diversity increased in all areas but the response diversity increased in left side and decreased in right side.

188 *H. Kahiluoto et al. / Global Environmental Change 25 (2014) 186–193*

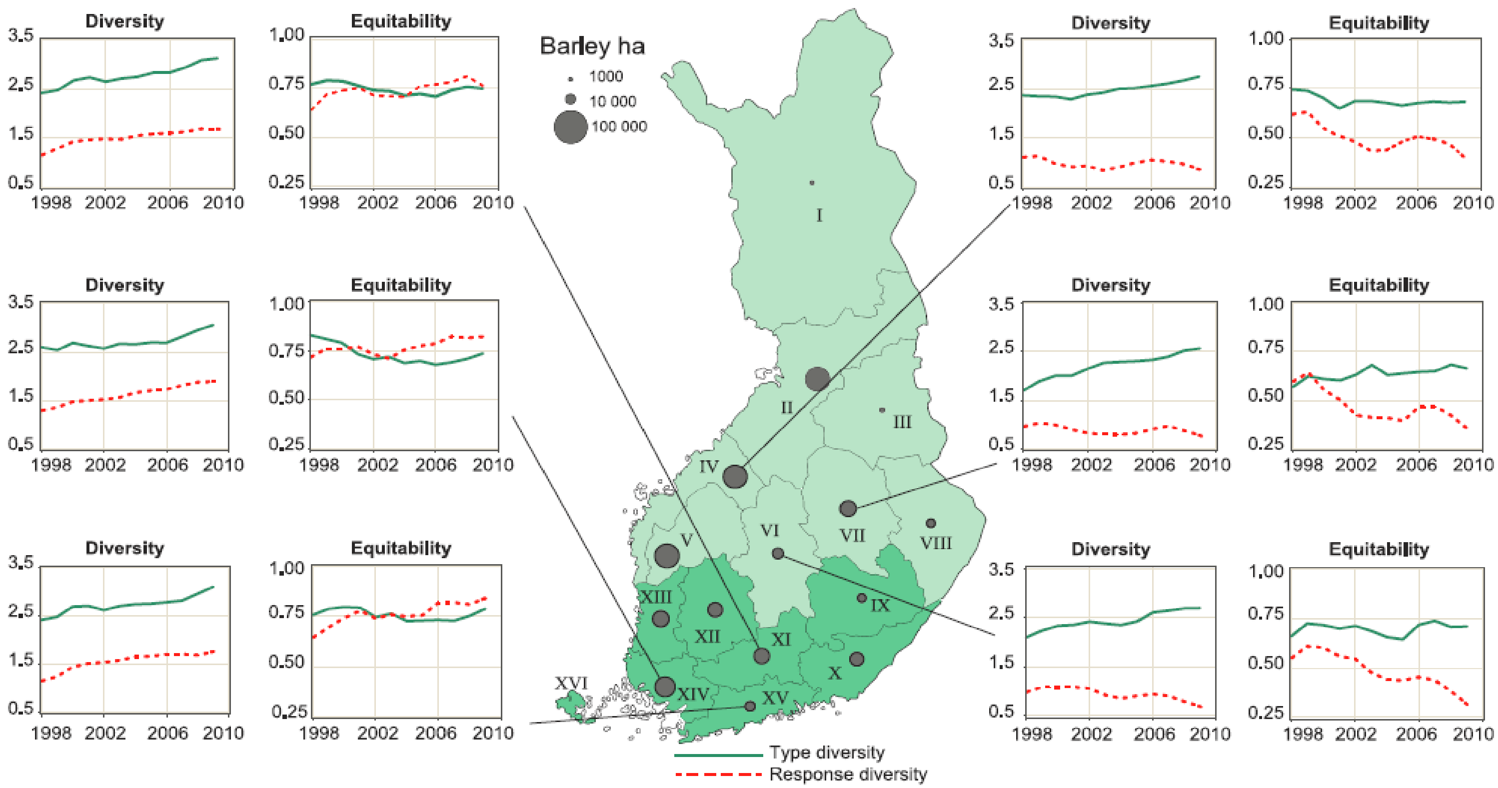

Fig. 2. Disparity between the Shannon indices and the equitabilities for the barley cultivar type diversity (continuous line) and response diversity (dashed line). Equitability represents the evenness component of the diversity indices which also include the component of richness. Equitability was calculated by dividing each value of the Shannon diversity index by the theoretical maximum for that value. The development in the regions with the smallest and greatest disparity between the indices since 2005 is shown. Dark green indicates the regions for which the disparity values were in the lower half of all regional values (the charts to the left). The size of the circles illustrates the barley cultivation area in 2005–2009. The Roman numerals refer to the regions that are presented in Table 1.

Demonstration of Response Diversity

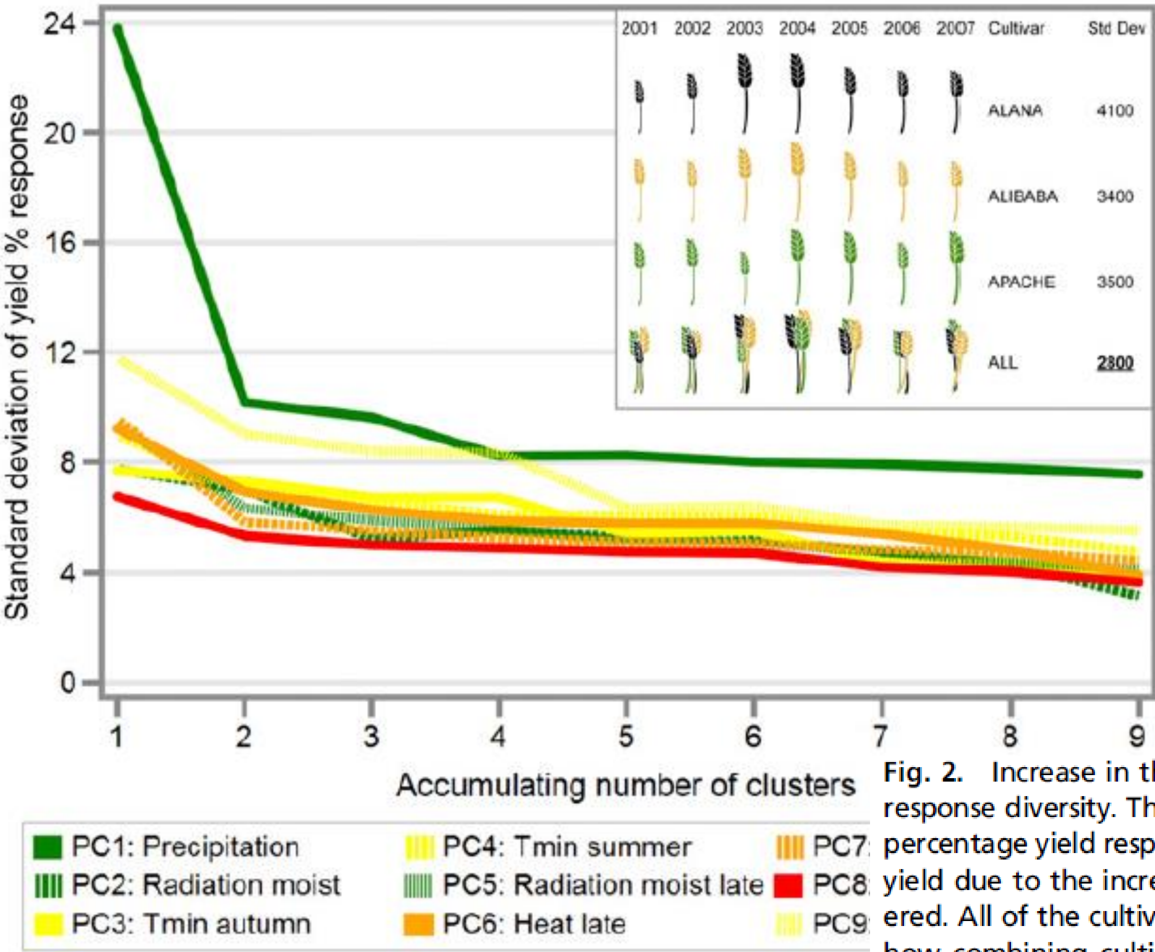

Fig. 2. Increase in the climate resilience of European wheat with increasing response diversity. The main figure shows the decrease in the variation in the percentage yield response to the weather patterns (agroclimatic PCs) critical to yield due to the increase in the number of weather response clusters considered. All of the cultivar yield data were utilized (n = 100,985). The box shows how combining cultivars from different clusters increases the yield stability under weather variability. The three exemplary cultivars (dark, yellow and green heads) represent clusters 1, 3 and 5, respectively, from Caslav, Czechia and were selected based on the largest number of observations and similar average yields (n = 78). If the cultivation area was evenly divided among the three cultivars from 2001 to 2007 in comparison with the cultivation of only the cultivar with the highest total yield (Apache), a 2% loss in total yield appeared, but the SD among the years declined by 16–32%. The relative size of the heads refers to the relative annual yields of the three cultivars.

Clustering of Cultivars
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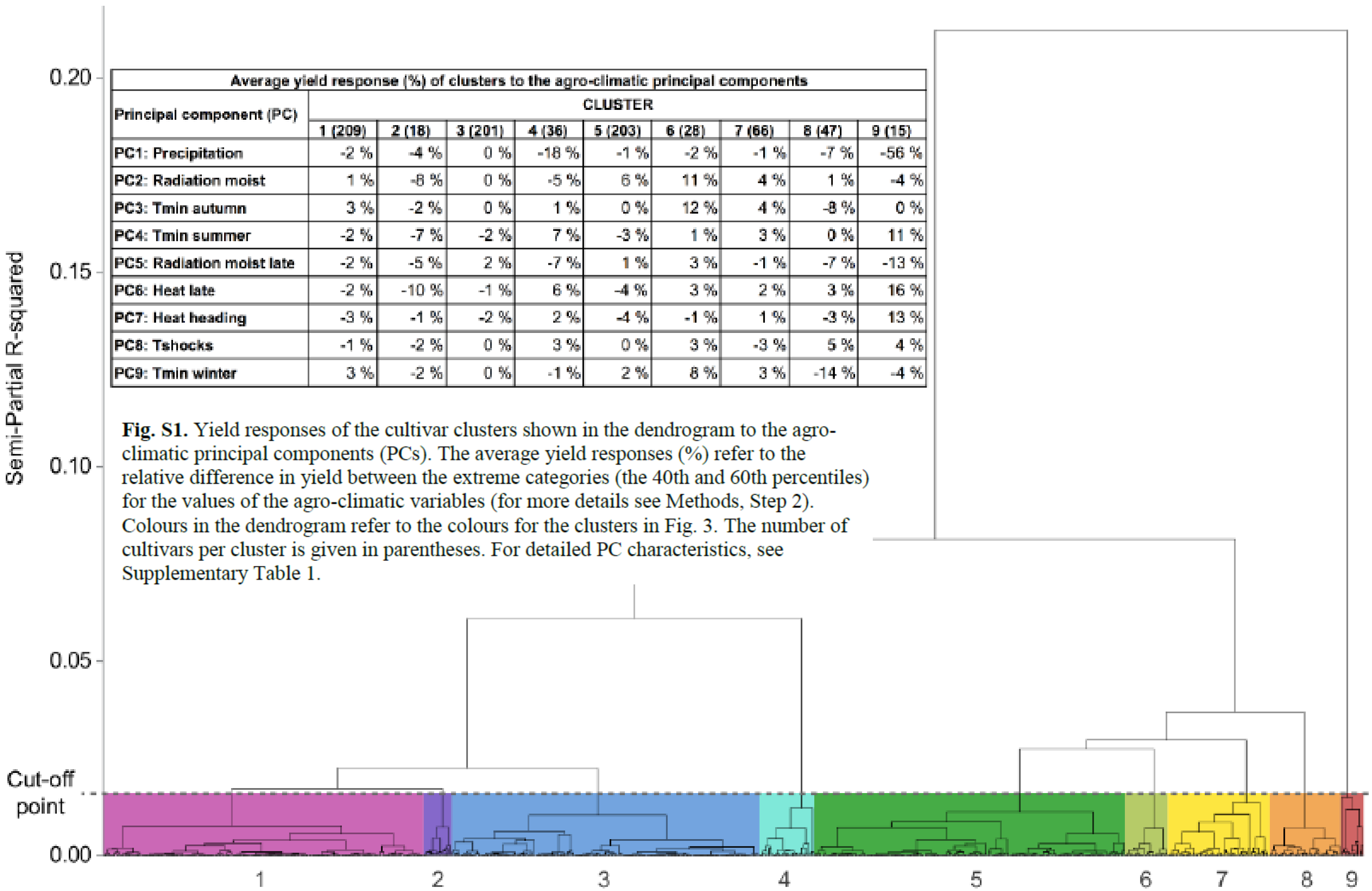


Average yield response (%) of clusters to the agro-climatic principal components									
Principal component (PC)	CLUSTER								
	1 (209)	2 (18)	3 (201)	4 (36)	5 (203)	6 (28)	7 (66)	8 (47)	9 (15)
PC1: Precipitation	-2 %	-4 %	0 %	-18 %	-1 %	-2 %	-1 %	-7 %	-56 %
PC2: Radiation moist	1 %	-8 %	0 %	-5 %	6 %	11 %	4 %	1 %	-4 %
PC3: Tmin autumn	3 %	-2 %	0 %	1 %	0 %	12 %	4 %	-8 %	0 %
PC4: Tmin summer	-2 %	-7 %	-2 %	7 %	-3 %	1 %	3 %	0 %	11 %
PC5: Radiation moist late	-2 %	-5 %	2 %	-7 %	1 %	3 %	-1 %	-7 %	-13 %
PC6: Heat late	-2 %	-10 %	-1 %	6 %	-4 %	3 %	2 %	3 %	16 %
PC7: Heat heading	-3 %	-1 %	-2 %	2 %	-4 %	-1 %	1 %	-3 %	13 %
PC8: Tshocks	-1 %	-2 %	0 %	3 %	0 %	3 %	-3 %	5 %	4 %
PC9: Tmin winter	3 %	-2 %	0 %	-1 %	2 %	8 %	3 %	-14 %	-4 %

Fig. S1. Yield responses of the cultivar clusters shown in the dendrogram to the agro-climatic principal components (PCs). The average yield responses (%) refer to the relative difference in yield between the extreme categories (the 40th and 60th percentiles) for the values of the agro-climatic variables (for more details see Methods, Step 2). Colours in the dendrogram refer to the colours for the clusters in Fig. 3. The number of cultivars per cluster is given in parentheses. For detailed PC characteristics, see Supplementary Table 1.

PCA structure of weather variables

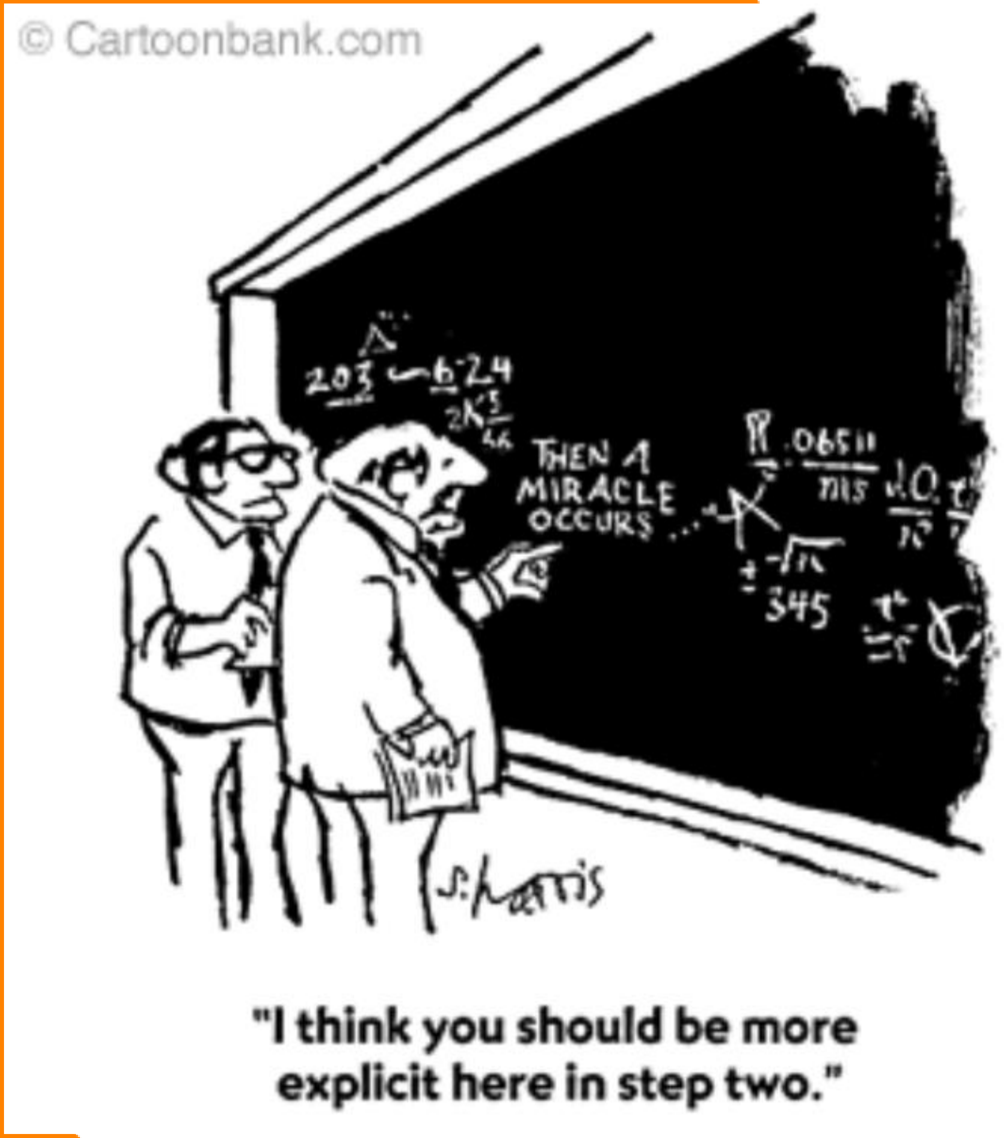
Rotated Factor Pattern				
	Temperature	Precipitation	Effective Tsum and radiation	Sowing
Heat stress days of >25C one week before through two weeks after heading (d)	0.91	-0.16	-0.04	-0.07
Tsum >5C accumulation rate per day from heading until yellow ripeness (C)	0.86	-0.13	0.06	-0.01
Heat stress days of >28C one week before through two weeks after heading (d)	0.82	0.32	0.10	0.05
Temperature sum (Tsum >5C) accumulation from 14 d before heading until heading (C)	0.62	-0.22	0.23	0.38
Number of days with rain (>1 mm) from sowing until yellow ripeness (d)	0.02	0.85	-0.10	0.05
Seasonal precipitation from sowing until yellow ripeness (mm)	-0.10	0.84	-0.16	-0.08
Drought 3–7 weeks after sowing indicated by accumulated precipitation (mm)	-0.02	0.69	0.04	0.06
Sum of effective growing days from sowing until yellow ripeness (d)	-0.40	0.57	0.51	0.07
Sum of effective global radiation from sowing until yellow ripeness	0.05	-0.30	0.82	0.00
Tsum >5C accumulation rate from heading until yellow ripeness (C)	0.18	-0.04	0.71	0.30
Precipitation during one month before sowing (mm)	-0.05	-0.25	-0.57	0.47
Deviation from a fixed early sowing date (d)	0.03	0.17	0.12	0.88

	Weather_1	Weather_2		Weather_43
Cultivar_1	-200	120	…	77
Cultivar_2	110	290	…	-322
…	…	…	…	…
Cultivar_920	-300	220	…	5

How to apply this in Diveraction?

- ✓ Investigating the clustering and distribution of crops and cultivars on the basis of location of farms
- ✓ Finding possible regional gaps, hotspots and desserts from a perspective of resilience
- ✓ The first objective of these WPs is to reduce yield gaps to ensure food security by speeding up realization of increased yield potential of new cultivars and to diverse monocultural crop rotations
- ✓ A diversity of responses to disturbance is considered a key determinant of resilience. <u>The capacity of a sole crop genotype to perform well under climatic variability is limited; therefore, a set of cultivars with diverse responses to weather conditions critical to crop yield is required.</u>
  - ✓ <u>When the key diversity that fosters resilience is identified, greater resilience can be achieved with less diversity.</u> Response diversity approach provides a practical means to assess and enhance resilience of food system actions important to food security.

Kiitos!



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