Relevant traits determining wheat yield in elite germplasm

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Introduction

- Wheat grain yield needs to be improved.
- Flowering time and plant height have been much exploited.
- Much of the yield improvements are brought about by increasing grain number (GN).
- Need for identifying new traits and trait combination - by evaluating crosses involving elite lines.
Aim: Identifying lines with relevant traits from the elite material which could be promising in practical breeding programs

Fruiting efficiency (FE) and spike dry weight at Anthesis (SDW) could be potential traits to improve GN (Slafer et al., 2015)

\[ FE = \frac{GN}{SDW_a} \]
Material and Methods

- 13 Bi-parental crosses of elite lines
- 231 best performing lines from 1200 NAM population (within family)
  - Lines with similar plant height
  - Similar flowering time
  - High GN
- Two field experiments- 2016-17 & 2017-18; in Bell-lloc, Lleida, Spain

List of bi-parental crosses

1. Weebill x CIMCOG3 (19)
2. Paragon x Pfau (15)
3. Paragon x Baj (17)
4. Paragon x Wayal (17)
5. Paragon x Becard x Kachu (17)
6. Paragon x MISR1 (18)
7. Paragon x Waxwing (17)
8. Paragon x CIMCOG49 (17)
9. Paragon x Super152 (18)
10. Paragon x Synth type (18)
11. Paragon x CIMCOG47 (19)
12. Paragon x Garcia (17)
13. Weebill x CIMCOG32 (22)
- **Phenological stages:**
  Seedling emergence, onset of tillering, onset of stem elongation (OSE), Flag leaf appearance, booting, heading, anthesis and physiological maturity.

- **Sampling at Anthesis and Maturity**
  - Harvesting plants in 1 m (35-45 plants)
  - Biomass distribution between organs- Shoots, spikes, leaves, grains dry weight
  - Grain yield components
Results

**Time to anthesis ($^0\text{Cd}$)**

- $R^2 = 0.51^{***}$

**Plant height (cm)**

- $R^2 = 0.55^{***}$

**Grain yield (g m$^{-2}$)**

- $R^2 = 0.01$
Correlations between traits

**Grain yield (g m⁻²) vs. Time to anthesis (° Cd)**
- $R^2_{2016-17} = 0.001$
- $R^2_{2017-18} = 0.06^{***}$

**Plant height (cm) vs. Grain yield (g m⁻²)**
- $R^2_{2016-17} = 0.01$
- $R^2_{2017-18} = 0.003$

**Grain number (m⁻²) vs. Grain yield (g m⁻²)**
- $R^2_{2016-17} = 0.64^{***}$
- $R^2_{2017-18} = 0.52^{***}$

**Fruiting efficiency (Grains g⁻¹)**
- $R^2_{2016-17} = 0.18^{***}$
- $R^2_{2017-18} = 0.27^{***}$
Selection of consistent performers

Grain yield (g m\(^{-2}\))

\[
y = 0.8201x + 193.93 \\
R^2 = 0.7161
\]
Correlations in consistent performers

- **Grain yield (g m\(^{-2}\))**
  - \(R^2_{2016-17} = 0.54***\)
  - \(R^2_{2017-18} = 0.43***\)

- **Grain number (m\(^{-2}\))**
  - \(R^2_{2016-17} = 0.24***\)
  - \(R^2_{2017-18} = 0.36***\)

- **Fruiting efficiency (Grains g\(_{\text{Spike}^{-1}}\))**
  - \(R^2_{2016-17} = 0.31***\)
  - \(R^2_{2017-18} = 0.42***\)

- **Average grain weight (mg Grain\(^{-1}\))**
  - \(R^2_{2016-17} = 0.01\)
  - \(R^2_{2017-18} = 0.01\)

- **Chaff weight (g m\(^{-2}\))**
  - \(R^2_{2016-17} = 0.01\)
  - \(R^2_{2017-18} = 0.01\)
Conclusions

- There was no GY compensation due to trade-off between FE and AGW, presumably later produced grains were **considerably smaller** in size.

- Our study supports that when **Rht** genes are not involved **FE** plays major role in improving GN.

- Stringent selection for **lines with high FE** through optimum SDW would generate prospect parents-promising in breeding.
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