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Supplementary material

Fig. S1. Wireless data logger and radio transmitter for monitoring soil moisture and soil temperature at the Yanco MEF. Soil moisture status is monitored using gypsum block soil moisture sensors at six different depths (25, 50, 75, 100, 125 and 150 cm). Soil temperature is monitored using thermistors at two different depths (25 and 100 cm). Data is transmitted to a central base station located onsite and then transmitted very two hours via mobile phone network to the internet. Data is also stored locally on each logger for redundancy.

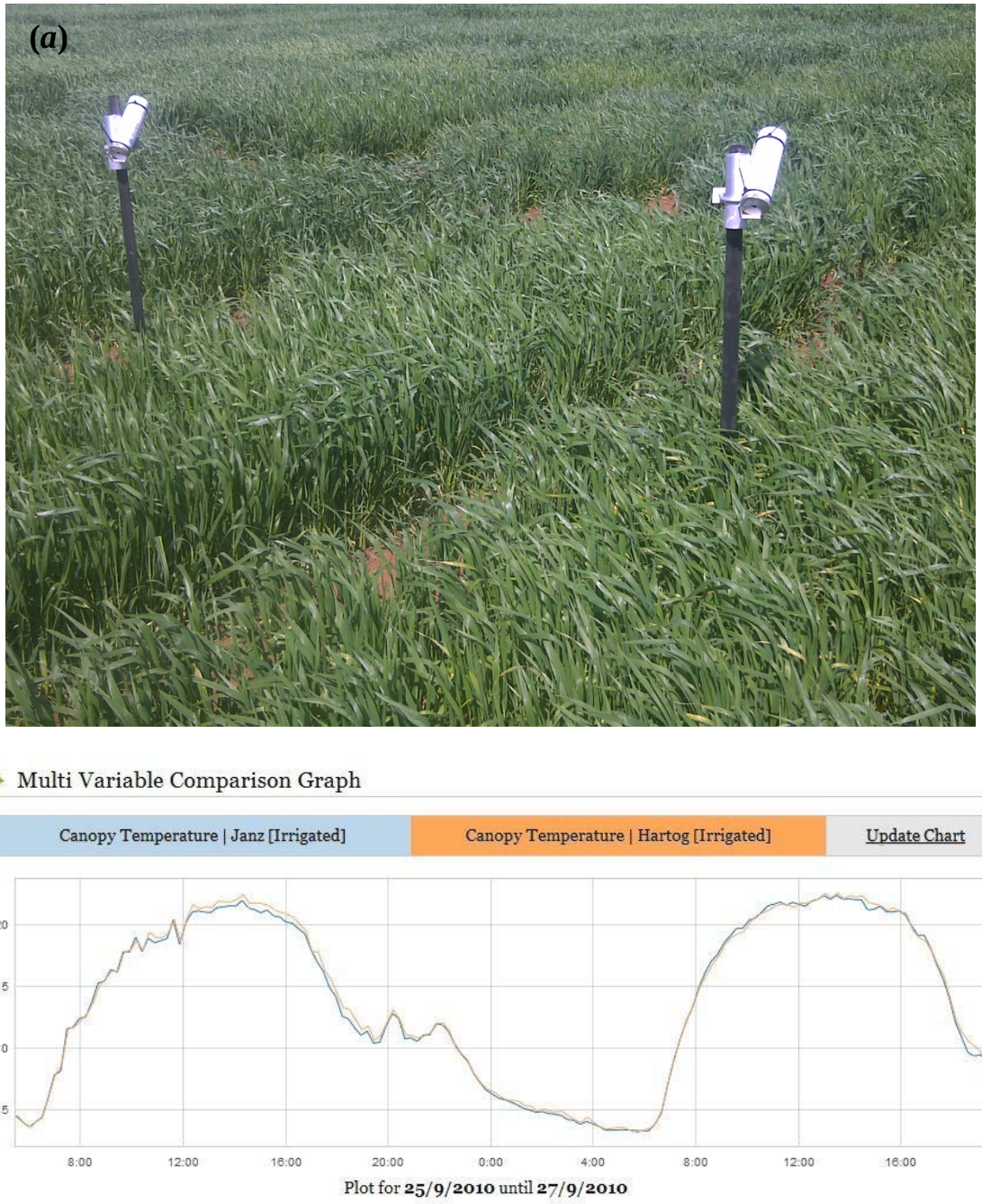

Fig. S2. Use of the Phenonet in monitoring of canopy temperature for multiple genotypes: (*a*) infra-red thermometers (Melexis®, 10 deg field of view) used for monitoring canopy temperature at the Yanco MEF; and (*b*) screen shot of the Phenonet visualisation and analysis system for near-real time recording of canopy temperature (here of wheat cultivars Janz (blue) and Hartog (orange) assessed under irrigated conditions).

Fig. S3. Purpose built crop monitoring buggy fitted with: four RGB cameras for measurement of ground cover and plant establishment; LiDAR sensors to measure plant height and bio-volume; spectral radiometer from 300 to 2500 nm to measure NDVI and various spectral vegetation indices; three infra-red temperature sensors for crop canopy temperature.

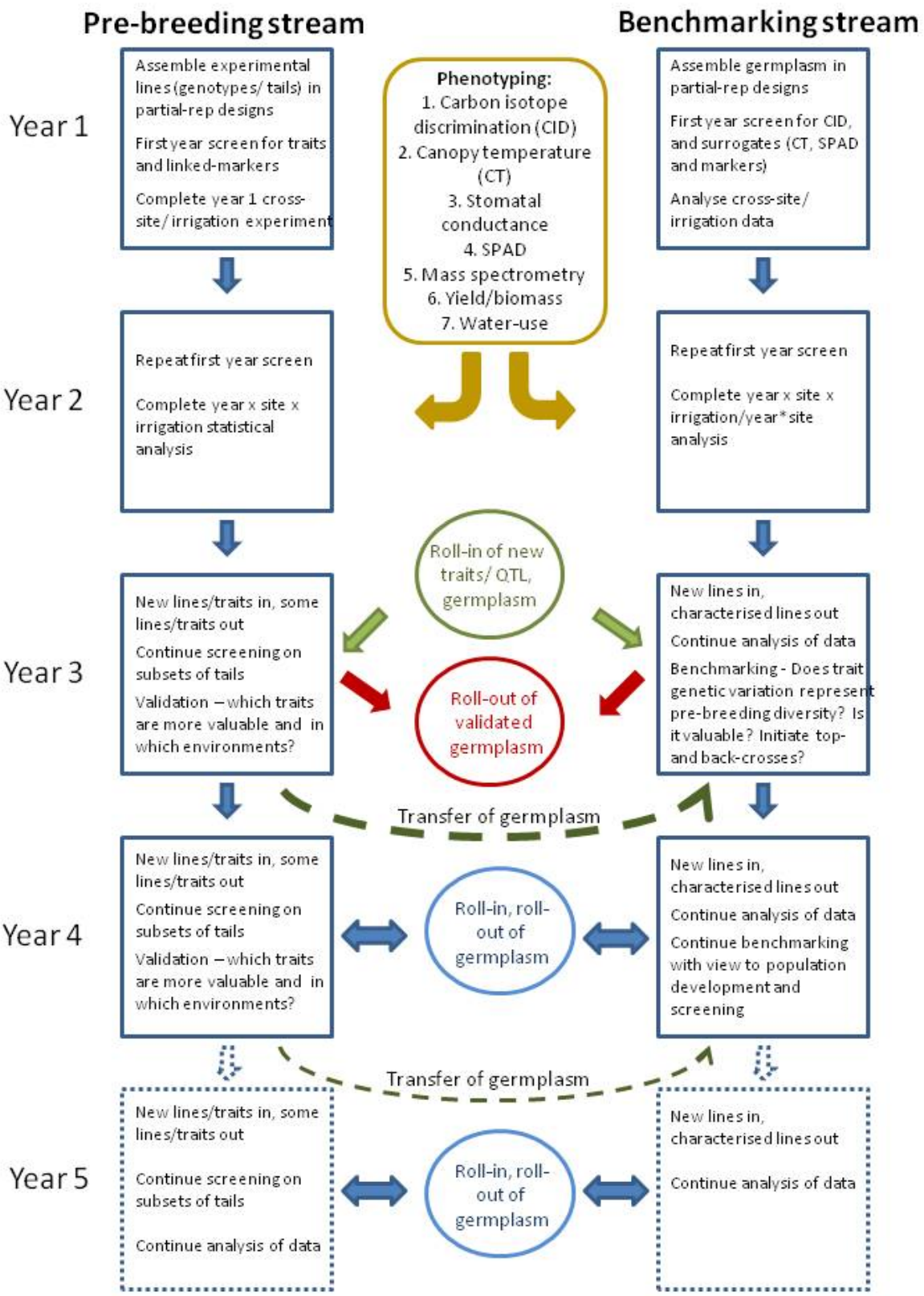

Fig. S4. Schematic summarising the validation and delivery of traits (e.g. carbon isotope discrimination and surrogates) assessed in the pre-breeding and benchmarking streams of the MEF.

Table S1. Sites, soils and management specifications used in the simulation of water-stress patterns.

Location	Latitude	Longitude	Soil PAWC [A] (mm)	PAW [B] (mm)	Soil Nitrogen [C] (kg ha^{-1})	Nitrogen application (kg ha^{-1})[D]	Sowing dates	Sowing density (plt m^{-2})
Merredin	–31.50	118.22	101	12-23-39-54-92	30	20-20-30*	1-May / 15-May / 1-Jun / 15-Jun	100
Narrabri	–30.32	149.78	218	105-148-174-214-218	30	130-0-0	1-May / 15-May / 1-Jun / 15-Jun	125
Yanco	–34.61	146.42	191	32-57-75-112-191	50	40-40$^{\top}$-40†	1-May / 15-May / 1-Jun / 15-Jun	100

[A] Plant available water capacity of the simulated soil type.

[B] Plant available soil water at sowing.

[C] Nitrogen in the soil profile at sowing.

[D] Split application of nitrogen fertiliser (sowing, stem elongation, flag leaf stage).

$^{\top}$, A 2nd nitrogen application was simulated when cumulative rainfall was greater than 100 mm.

* A 3rd nitrogen application was simulated when PAW was >60 mm.

† A 3rd nitrogen application was simulated or when PAW was >60% of PAWC.