The value of tactical adaptation to El Niño–Southern Oscillation for Eastern Australian wheat

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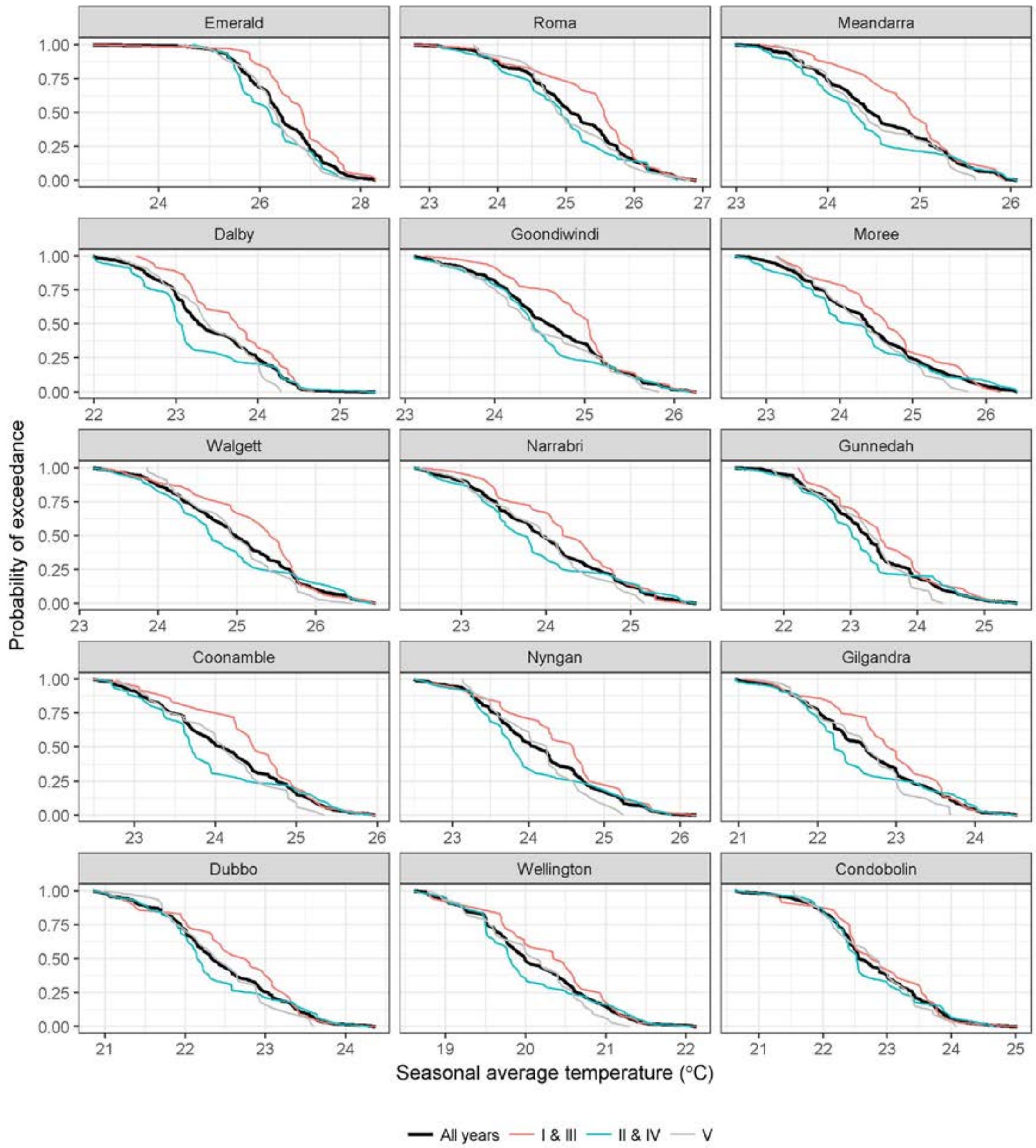

Figure S1 Cumulative probability distributions (probability of exceedance) of 'summer' average temperature for the three SOI classes, singly (SOI phases I & III, II & IV and V) and combined ('all years') for 1900-2016 at the 15 studied sites across the Australian Eastern wheatbelt. The three SOI classes were determined in March-April and correspond to SOI consistently negative and rapidly failing (SOI phases I & III), SOI consistently positive and rapidly rising (SOI phases II & IV), and SOI consistently near zero (SOI phase V). 'Summer' data were recorded from November to April (i.e. prior to the determination of the SOI classes in March-April).

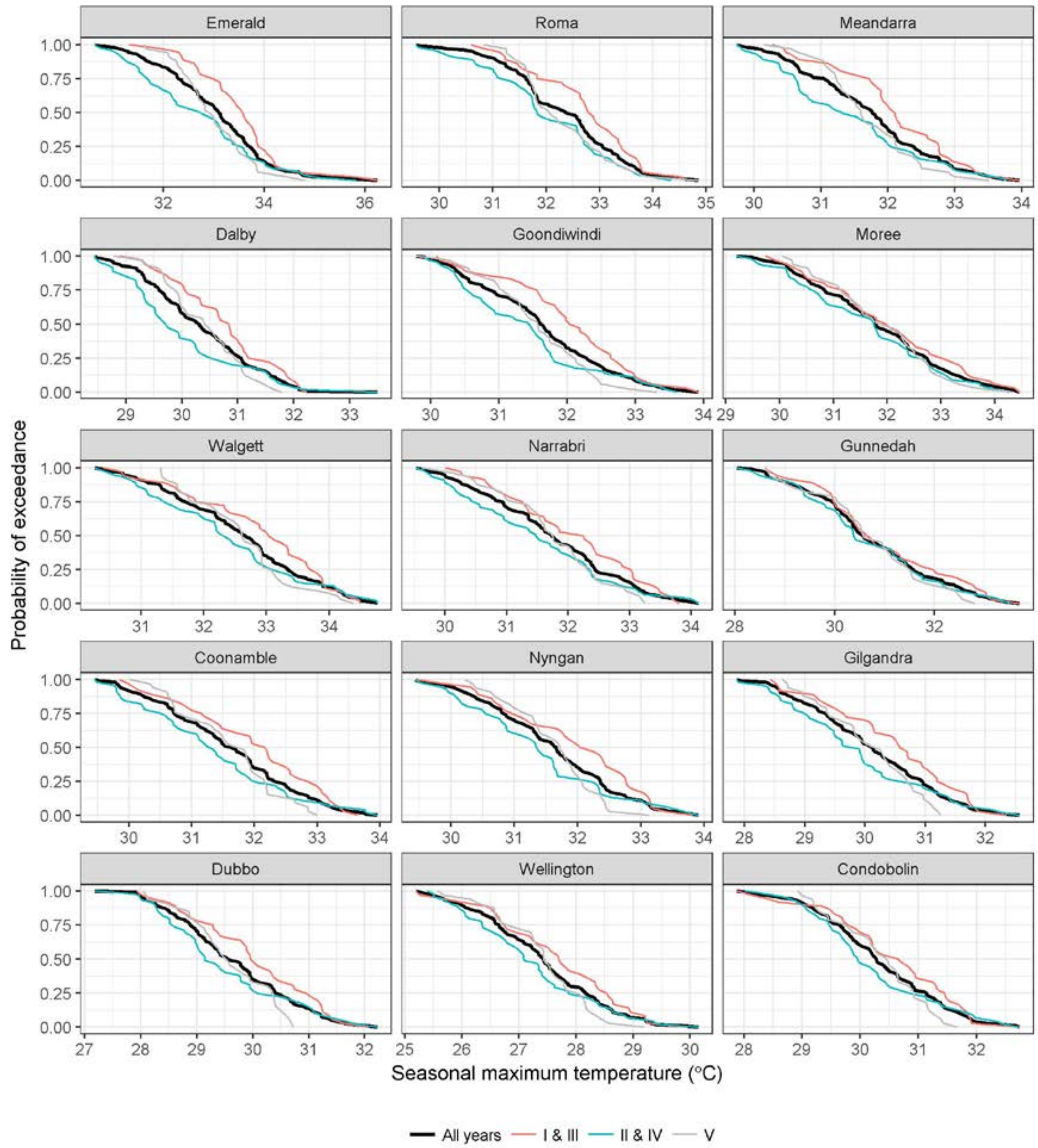

Figure S2 Cumulative probability distributions (probability of exceedance) of 'summer' maximum temperature for the three SOI classes, singly (SOI phases I & III, II & IV and V) and combined ('all years') for 1900-2016 at the 15 studied sites across the Australian Eastern wheatbelt. The three SOI classes were determined in March-April and correspond to SOI consistently negative and rapidly failing (SOI phases & III), SOI consistently positive and rapidly rising (SOI phases II & IV), and SOI consistently near zero (SOI phase V). 'Summer' data were recorded from November to April (i.e. prior to the determination of the SOI classes in March-April).

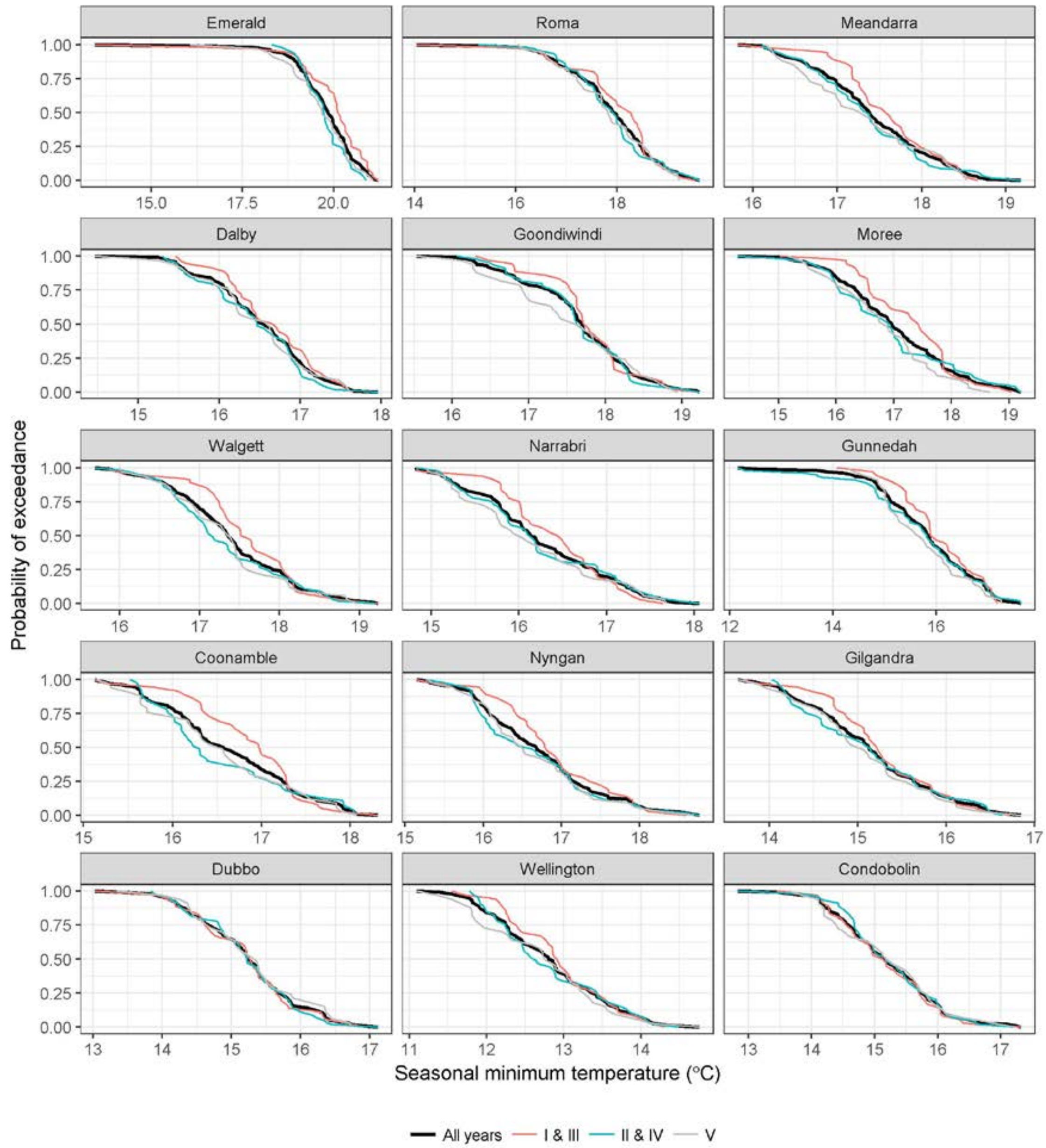

Figure S3 Cumulative probability distributions (probability of exceedance) of 'summer' minimum temperature for the three SOI classes, singly (SOI phases I & III, II & IV and V) and combined ('all years') for 1900-2016 at the 15 studied sites across the Australian Eastern wheatbelt. The three SOI phases were determined in March-April and correspond to SOI consistently negative and rapidly failing (SOI phases I & III), SOI consistently positive and rapidly rising (SOI phases II & IV), and SOI consistently near zero (SOI phase V). 'Summer' data were recorded from November to April (i.e. prior to the determination of the SOI classes in March-April).

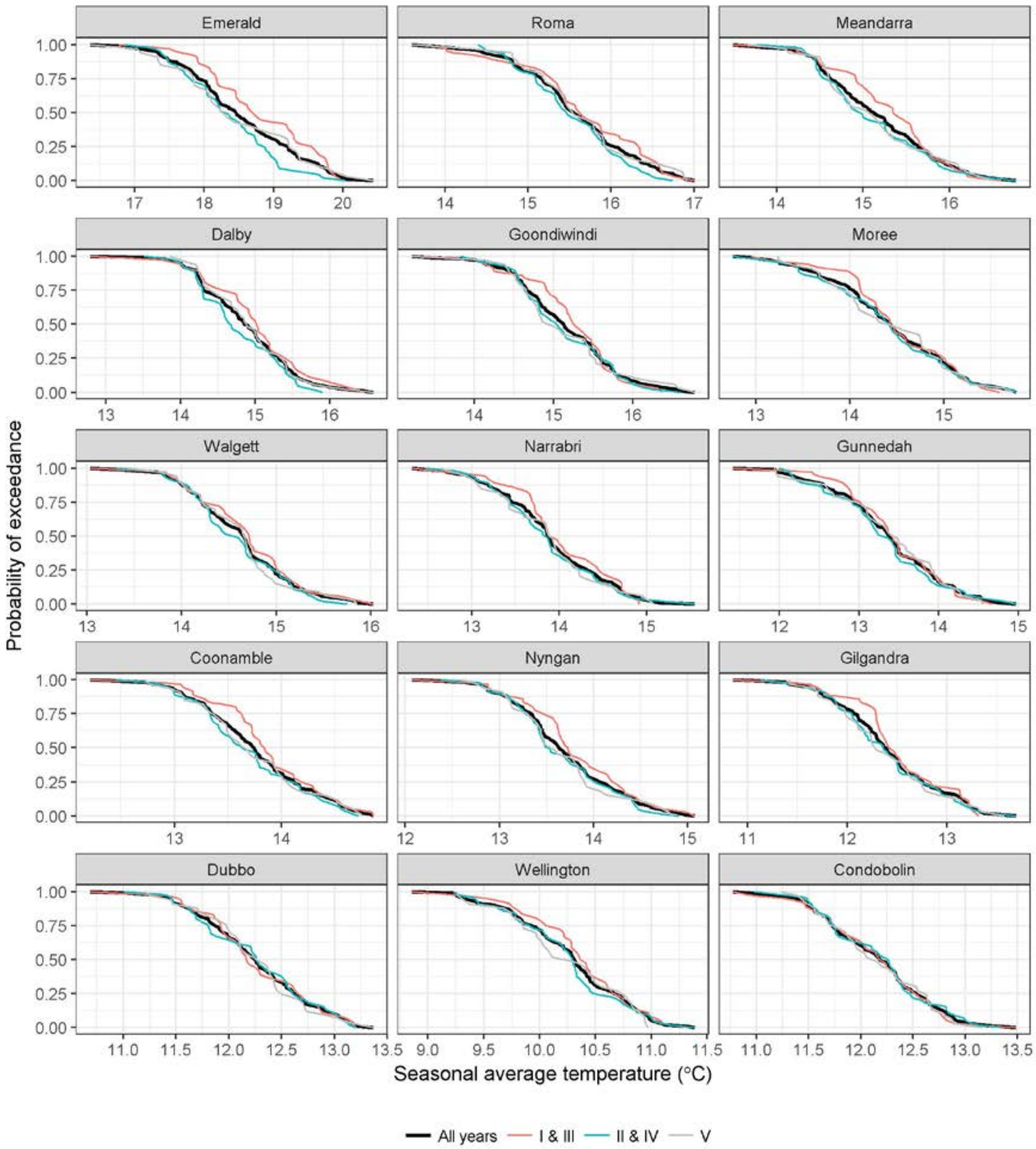

Figure S4 Cumulative probability distributions (probability of exceedance) of 'winter' average temperature for the three SOI classes, singly (SOI phases I & III, II & IV and V) and combined ('all years') for 1900-2016 at the 15 studied sites across the Australian Eastern wheatbelt. The three SOI classes were determined in March-April and correspond to SOI consistently negative and rapidly failing (SOI phases I & III), SOI consistently positive and rapidly rising (SOI phases II & IV), and SOI consistently near zero (SOI phase V). 'Winter' data were recorded from May to October.

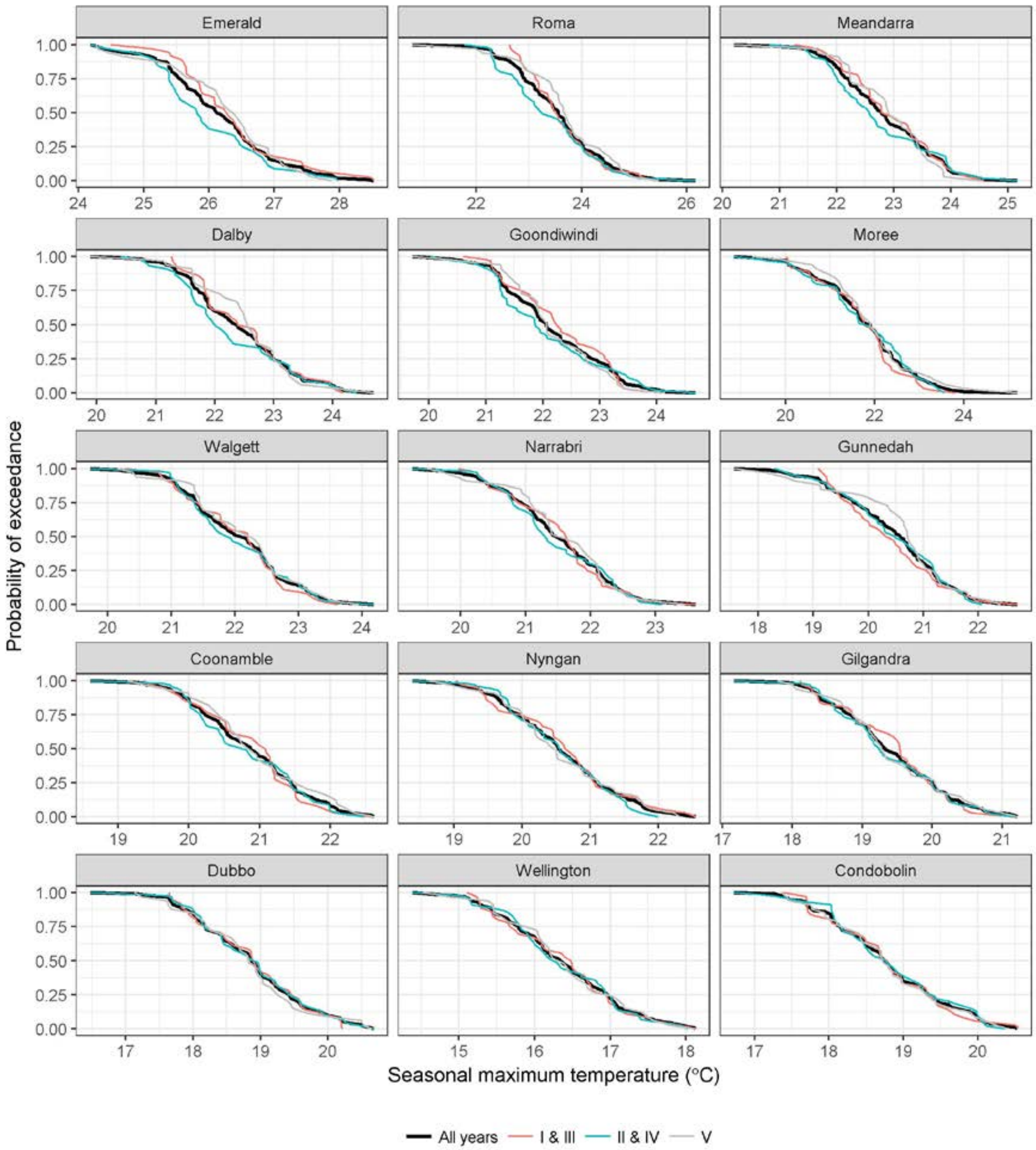

Figure S5 Cumulative probability distributions (probability of exceedance) of 'winter' maximum temperature for the three SOI classes, singly (SOI phases I & III, II & IV and V) and combined ('all years') for 1900-2016 at the 15 studied sites across the Australian Eastern wheatbelt. The three SOI classes were determined in March-April and correspond to SOI consistently negative and rapidly failing (SOI phases I & III), SOI consistently positive and rapidly rising (SOI phases II & IV), and SOI consistently near zero (SOI phase V). 'Winter' data were recorded from May to October.

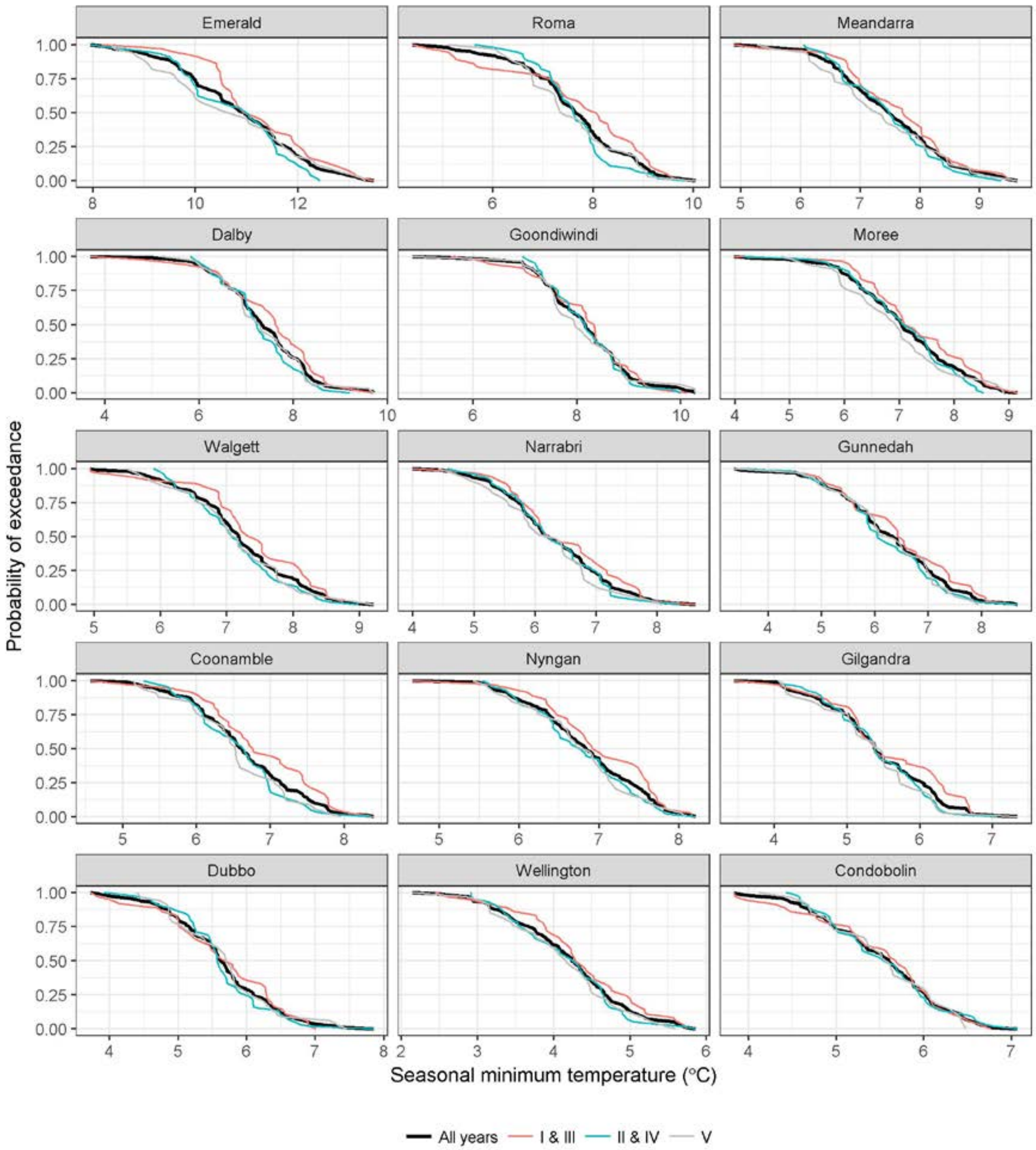

Figure S6 Cumulative probability distributions (probability of exceedance) of 'winter' minimum temperature for the three SOI classes, singly (SOI phases I & III, II & IV and V) and combined ('all years') for 1900-2016 at the 15 studied sites across the Australian Eastern wheatbelt. The three SOI classes were determined in March-April and correspond to SOI consistently negative and rapidly failing (SOI phases I & III), SOI consistently positive and rapidly rising (SOI phases II & IV), and SOI consistently near zero (SOI phase V). 'Winter' data were recorded from May to October.

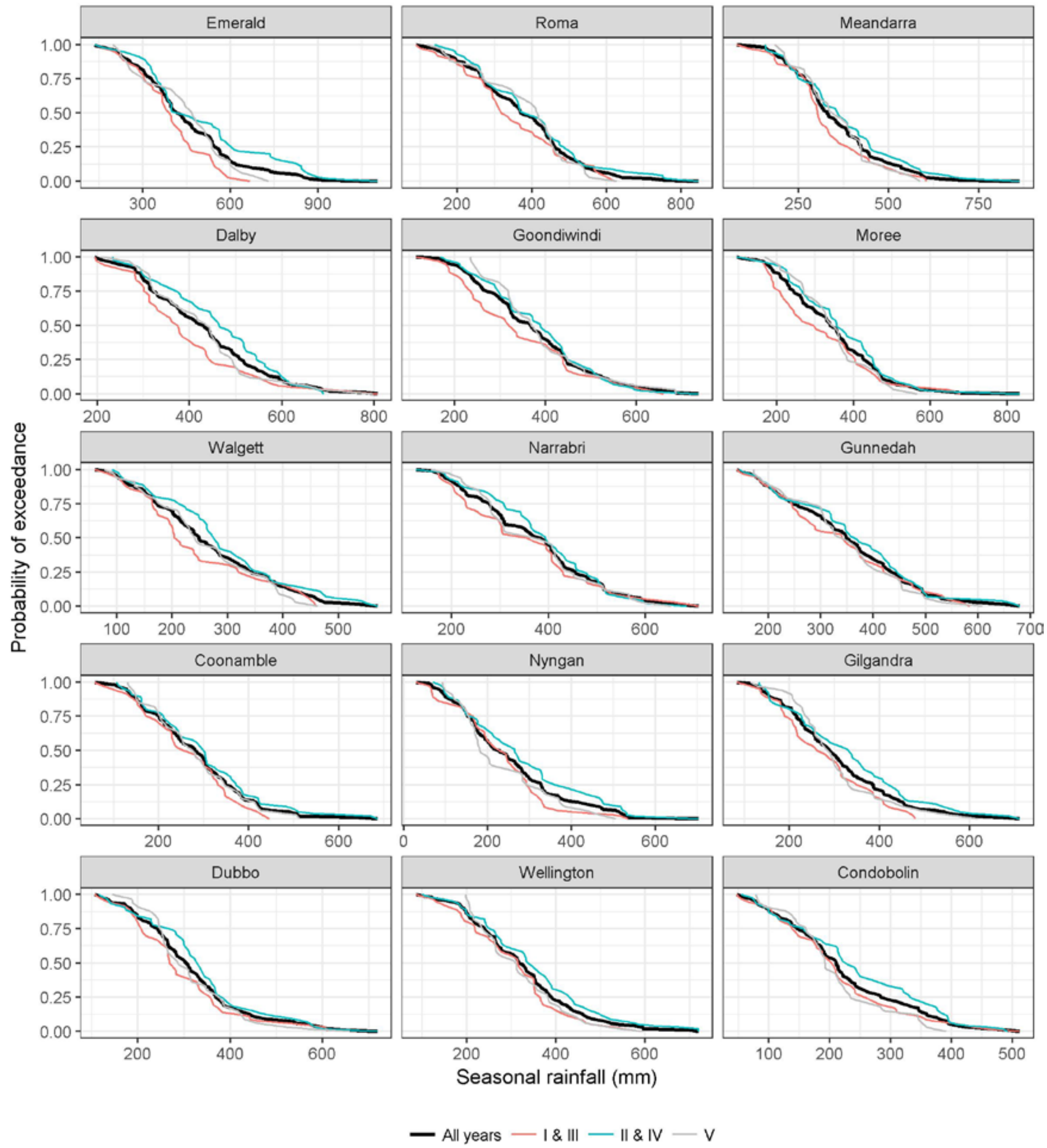

Figure S7 Cumulative probability distributions (probability of exceedance) of 'summer' total rainfall for the three SOI classes, singly (SOI phases I & III, II & IV and V) and combined ('all years') for 1900-2016 at the 15 studied sites across the Australian Eastern wheatbelt. The three SOI classes were determined in March-April and correspond to SOI consistently negative and rapidly failing (SOI phases I & III), SOI consistently positive and rapidly rising (SOI phases II & IV), and SOI consistently near zero (SOI phase V). 'Summer' data were recorded from November to April (i.e. prior to the determination of the SOI classes in March-April).

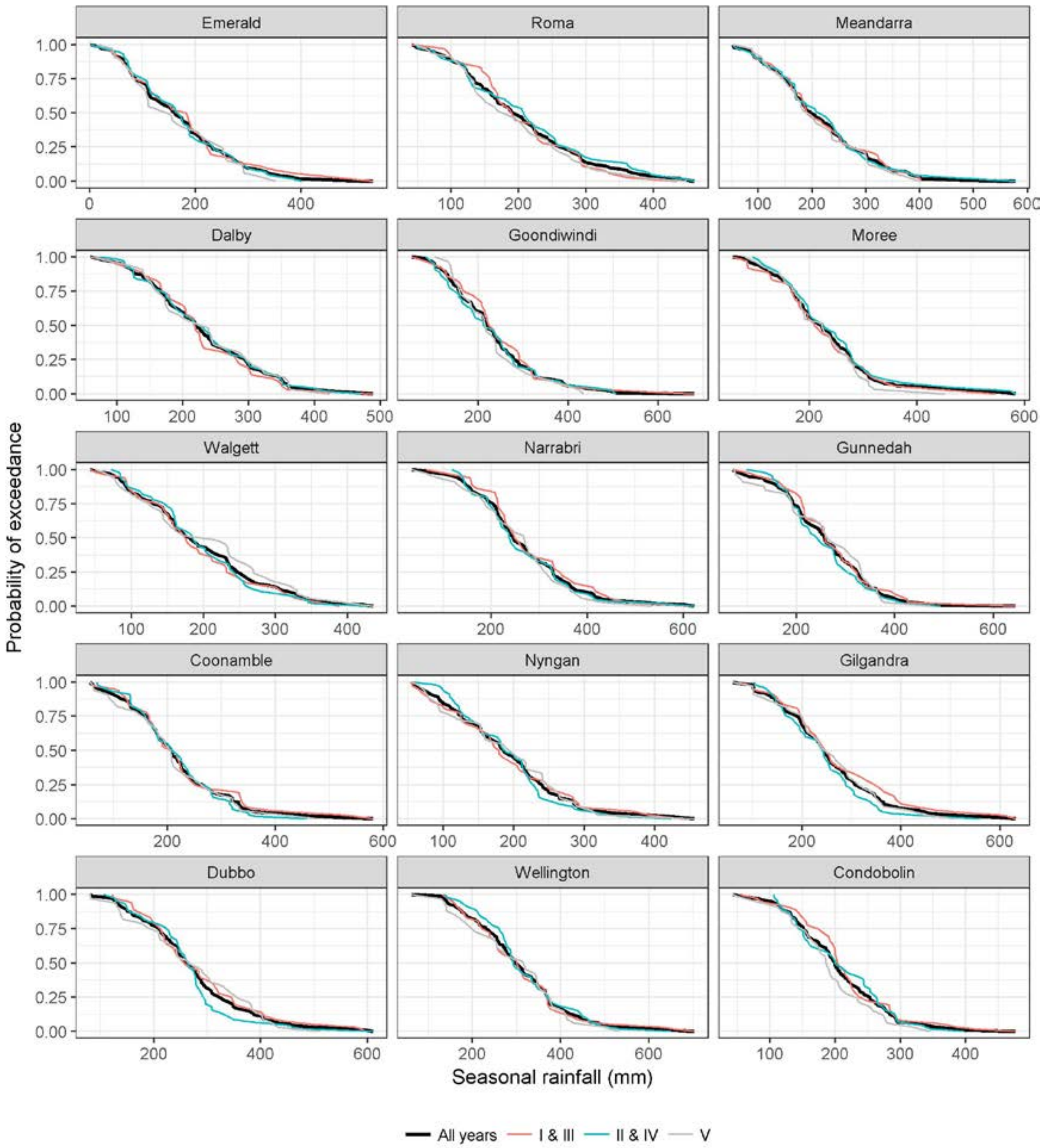

Figure S8 Cumulative probability distributions (probability of exceedance) of 'winter' total rainfall for the three SOI classes, singly (SOI phases I & III, II & IV and V) and combined ('all years') for 1900-2016 at the 15 studied sites across the Australian Eastern wheatbelt. The three SOI classes were determined in March-April and correspond to SOI consistently negative and rapidly failing (SOI phases I & III), SOI consistently positive and rapidly rising (SOI phases II & IV), and SOI consistently near zero (SOI phase V). 'Winter' data were recorded from May to October.

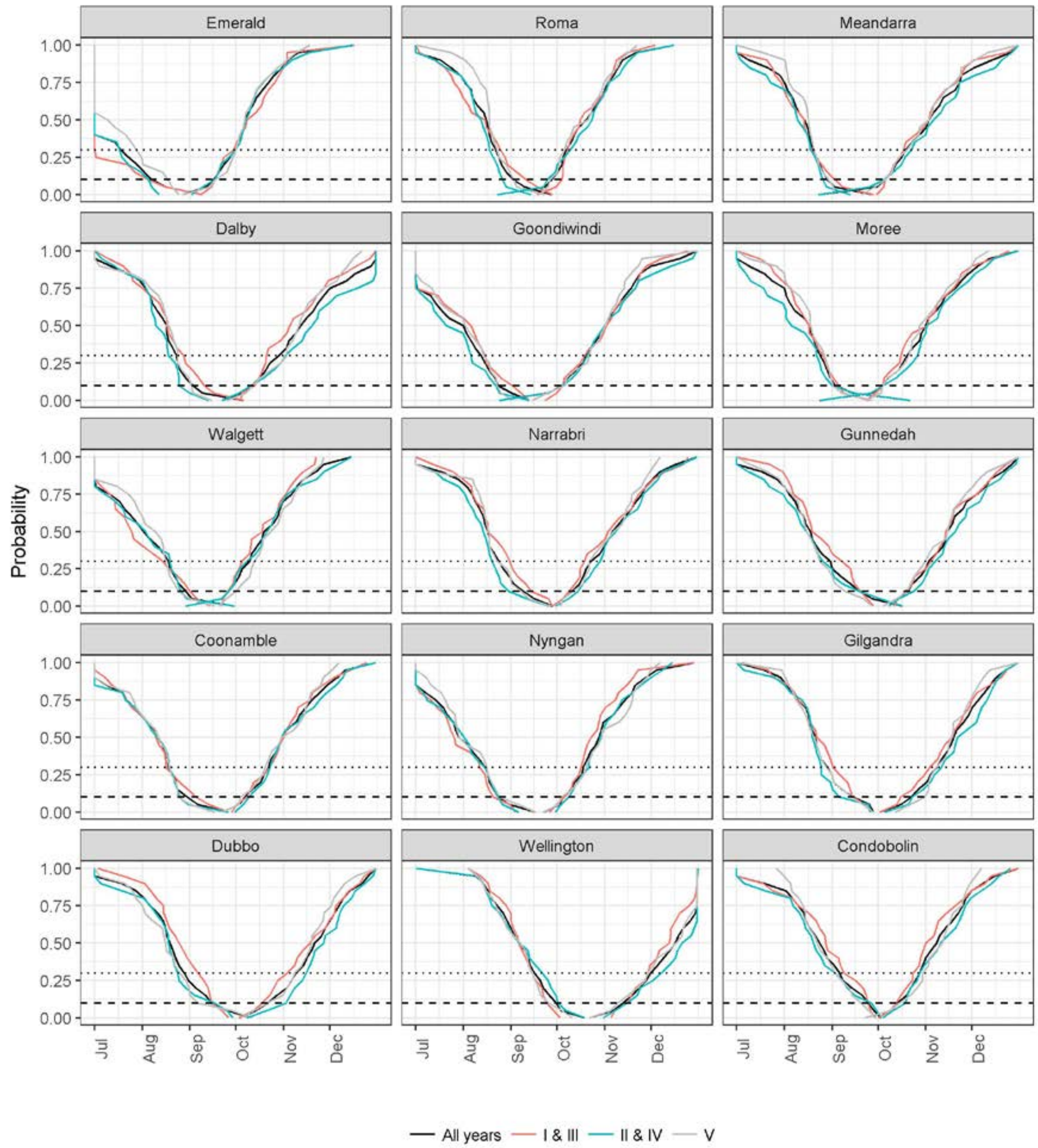

Figure S9 Probability of last frost day and first heat day for the three SOI classes, singly (SOI phases I & III, II & IV and V) and combined ('all years') for 1900-2016 at the 15 studied sites across the Australian Eastern wheatbelt. The three SOI classes were determined in March-April and correspond to SOI consistently negative and rapidly failing (SOI phases I & III), SOI consistently positive and rapidly rising (SOI phases II & IV), and SOI consistently near zero (SOI phase V). The last frost day corresponds to the last day of year with a minimum air temperature below 0oC. First heat day was defined as the first day after autumn with a maximum air temperature above 35oC. The dashed and dotted lines represent 10% frost risk and 30% heat risk, respectively. The period from a last frost day with 10% frost risk and a first heat day with 30% heat risk corresponds the safe flowering window in terms of frost and heat.

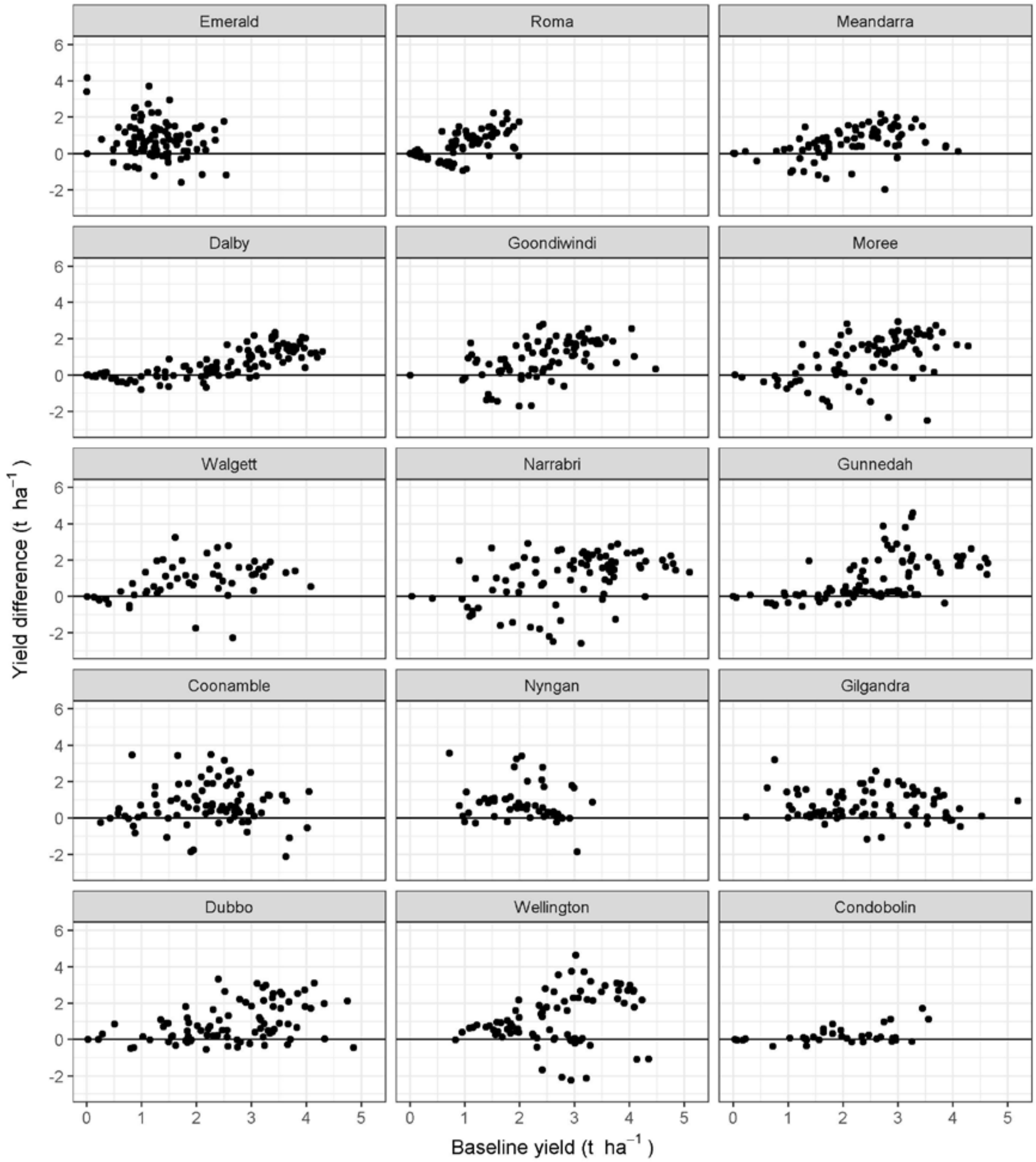

Figure S10 Simulated yield advantage of fixed adaptation over the baseline scenario. The yield difference is calculated for each year. The fixed adaptation scenario corresponds to optimized genotype and management across all years at each site. The baseline corresponds to simulated yield for a medium-season cultivar Janz, which was sown at semi-optimum sowing date (May 21) with no extra nitrogen input.

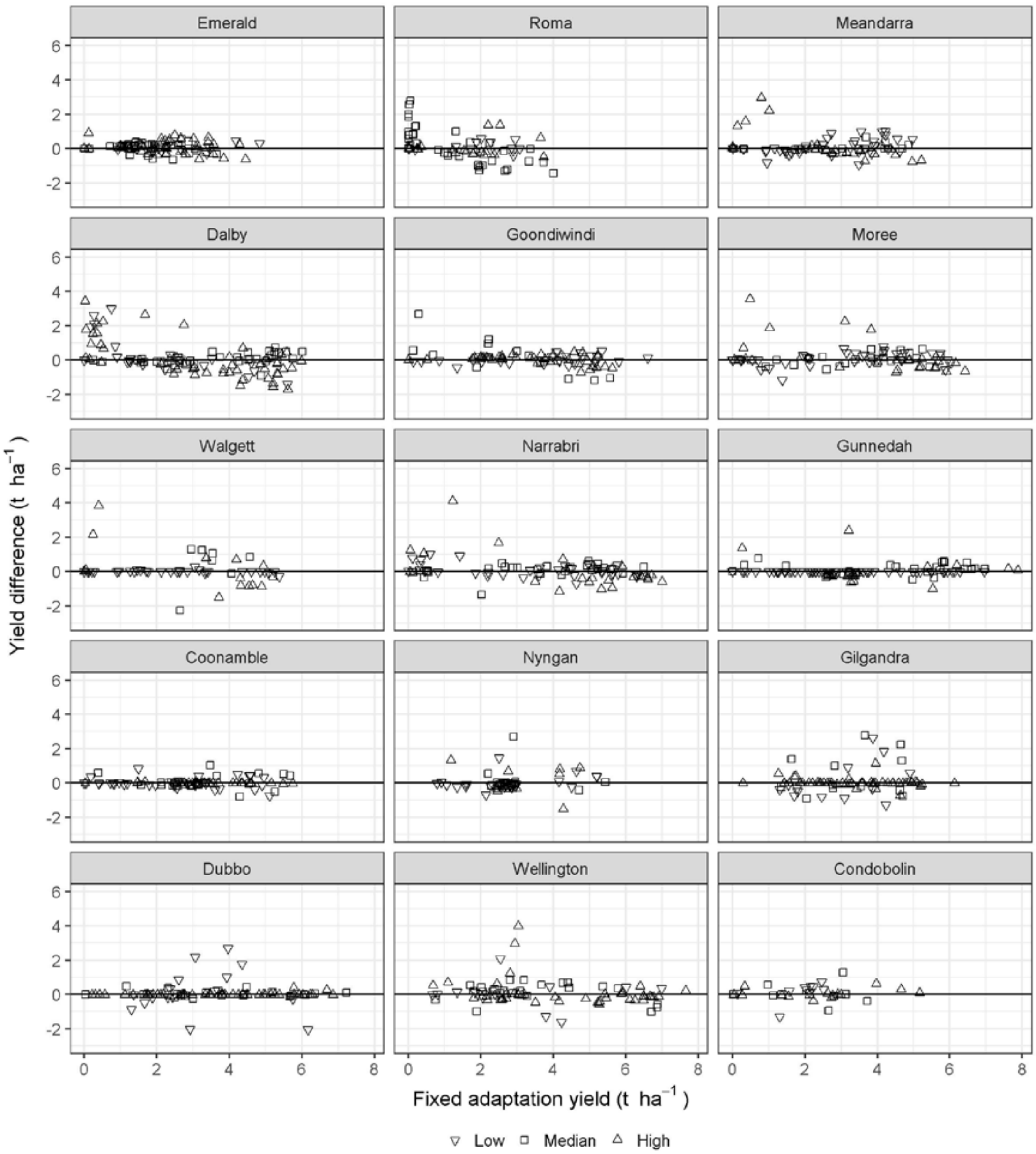

Figure S11 Simulated yield advantage of PAW tactical adaptation scenario over fixed adaptation scenario. The yield difference is calculated for each year. The fixed adaptation scenario corresponds to optimized genotype and management across all years at each site. The PAW tactical adaptation scenario corresponds to optimized genotype and management within each PAW (plant available water) group for each site.

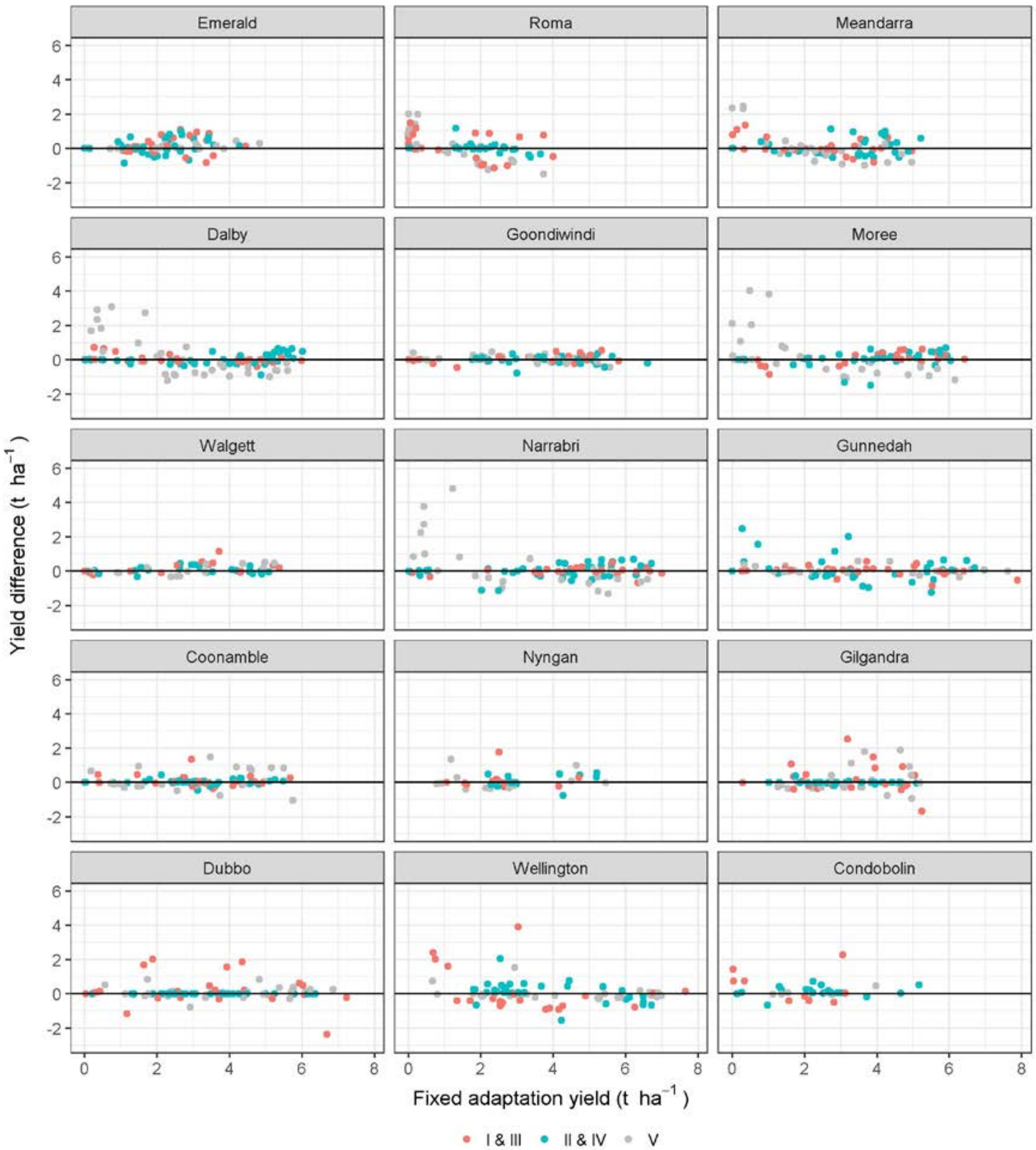

Figure S12 Simulated yield advantage of SOI tactical adaptation scenario over fixed adaptation scenario. The yield difference is calculated for each year. The fixed adaptation scenario corresponds to optimized genotype and management across all years at each site. The SOI tactical adaptation scenario corresponds to optimized genotype and management within each SOI class, for each site.

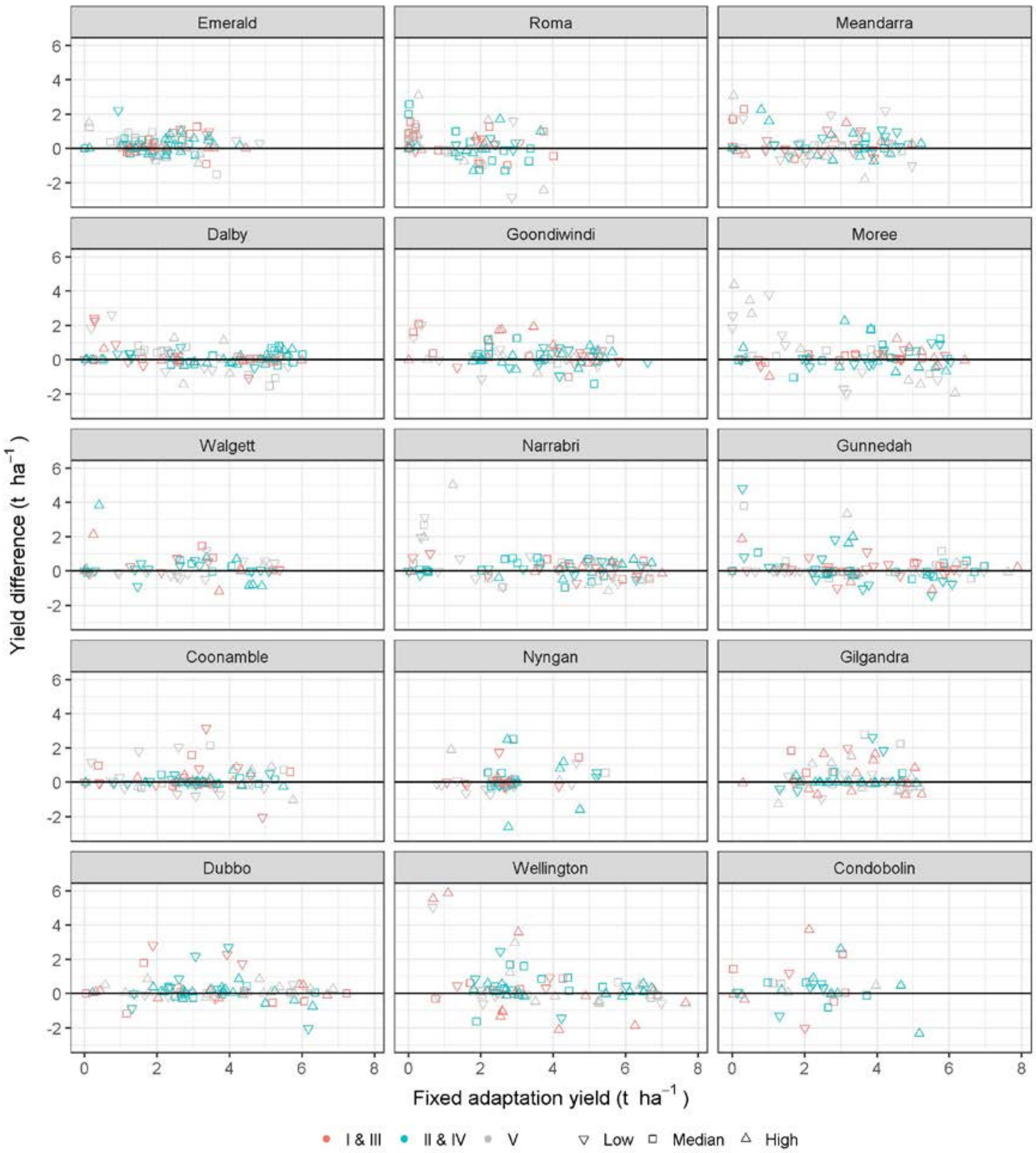

Figure S13 Simulated yield advantage of PAW & SOI tactical adaptation scenario over fixed adaptation scenario. The yield difference is calculated for each year. The fixed adaptation scenario corresponds to optimized genotype and management across all years at each site. The PAW & SOI tactical adaptation scenario corresponds to optimized genotype and management for each PAW (plant available water) group x SOI class combination, at each site.