



Effect on wheat (*Triticum aestivum* L.) four synthetic hexaploid genotypes and two spring cultivars (Simultaneous)

The net impact of individual and combined stress on plant growth

Plant- Wheat
Stress 1- Drought
Stress 2- Heat

Table showing the effect of individual and combined stress on yield and yield attributing traits in wheat four hexaploid genotype and two spring cultivars

Parameters studied	Genotypes/cultivars	Plant response to stress (reduction over control %)			Parameter type *
		Drought stress (withhold watering for 16 days)	Heat stress (36/30 °C day/night for 16 days)	Combined stress (Drought + heat)	
Experiment-I (stress at anthesis stage)					
Grain yield	ALTAR 48/ <i>Aegilops tauschii</i> Coss. (WX193)	76.25 ↓	95.00 ↓	97.50 ↓	Type A
	ALTAR 84/AO 'S'	59.01 ↓	67.00 ↓	82.00 ↓	
	GAN/A. touschii (WX897)	68.75 ↓	95.00 ↓	97.50 ↓	
	GR'S/Boy'S'	55.77 ↓	90.38 ↓	96.15 ↓	
	Halberd	73.73 ↓	78.35 ↓	88.94 ↓	
	Dharwar Dry	72.60 ↓	67.81 ↓	93.84 ↓	
Individual grain weight	ALTAR 48/ <i>Aegilops tauschii</i> Coss. (WX193)	61.50 ↓	88.04 ↓	91.68 ↓	Type A
	ALTAR 84/AO 'S'	34.33 ↓	51.23 ↓	77.12 ↓	
	GAN/A. touschii (WX897)	33.74 ↓	94.77 ↓	95.77 ↓	
	GR'S/Boy'S'	31.18 ↓	72.57 ↓	85.05 ↓	
	Halberd	46.67 ↓	46.23 ↓	77.03 ↓	
	Dharwar Dry	43.65 ↓	47.69 ↓	78.70 ↓	
Grain number per spike	ALTAR 48/ <i>Aegilops tauschii</i> Coss. (WX193)	7.81 ↓	31.95 ↓	38.54 ↓	Type A
	ALTAR 84/AO 'S'	6.59 ↓	13.42 ↓	17.32 ↓	
	GAN/A. touschii (WX897)	7.32 ↓	15.12 ↓	21.95 ↓	
	GR'S/Boy'S'	3.90 ↓	11.95 ↓	22.93 ↓	



Stress Combination and their Interaction in Plants (SCIP) Database

Website link- <http://www.nipgr.ac.in/scipdb.php>

	Halberd	7.56 ↓	14.63 ↓	23.41 ↓	
	Dharwar Dry	2.44 ↓	17.81 ↓	32.93 ↓	
Leaf chlorophyll content (SPAD unit)	ALTAR 48/ <i>Aegilops tauschii</i> Coss. (WX193)	7.04 ↓	15.79 ↓	25.02 ↓	Type B
	ALTAR 84/AO 'S'	4.13 ↓	10.93 ↓	19.68 ↓	
	GAN/A. touschii (WX897)	5.10 ↓	15.06 ↓	28.66 ↓	
	GR'S/Boy'S'	3.64 ↓	13.60 ↓	25.99 ↓	
	Halberd	2.19 ↓	11.42 ↓	22.35 ↓	
	Dharwar Dry	7.04 ↓	15.30 ↓	27.93 ↓	
The maximum quantum yield of PSII	ALTAR 48/ <i>Aegilops tauschii</i> Coss. (WX193)	NA	NA	NA	
	ALTAR 84/AO 'S'	NA	NA	NA	
	GAN/A. touschii (WX897)	NA	NA	NA	
	GR'S/Boy'S.'	NA	NA	NA	
	Halberd	NA	NA	NA	
	Dharwar Dry	NA	NA	NA	
Experiment-II (stress 21 days after anthesis)					
Grain yield	ALTAR 48/ <i>Aegilops tauschii</i> Coss. (WX193)	15.36 ↓	29.61 ↓	38.72 ↓	Type A
	ALTAR 84/AO 'S'	25.88 ↓	41.26 ↓	60.68 ↓	
	GAN/A. touschii (WX897)	35.02 ↓	55.37 ↓	64.44 ↓	
	GR'S/Boy'S.'	8.99 ↓	29.25 ↓	42.76 ↓	
	Halberd	24.16 ↓	39.50 ↓	45.09 ↓	
	Dharwar Dry	47.12 ↓	32.64 ↓	59.57 ↓	
Individual grain weight	ALTAR 48/ <i>Aegilops tauschii</i> Coss. (WX193)	17.59 ↓	32.54 ↓	38.71 ↓	
	ALTAR 84/AO 'S'	18.42 ↓	40.92 ↓	62.07 ↓	
	GAN/A. touschii (WX897)	36.78 ↓	56.85 ↓	66.23 ↓	



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	GR'S/Boy'S'	12.07 ↓	42.38 ↓	52.07 ↓	
	Halberd	24.13 ↓	30.31 ↓	47.72 ↓	
	Dharwar Dry	46.71 ↓	33.73 ↓	59.16 ↓	
Grain number per spike	ALTAR 48/ <i>Aegilops tauschii</i> Coss. (WX193)	NA	NA	NA	
	ALTAR 84/AO 'S'	NA	NA	NA	
	GAN/A. touschii (WX897)	NA	NA	NA	
	GR'S/Boy'S.'	NA	NA	NA	
	Halberd	NA	NA	NA	
	Dharwar Dry	NA	NA	NA	
Leaf chlorophyll content (SPAD unit)	ALTAR 48/ <i>Aegilops tauschii</i> Coss. (WX193)	11.63 ↓	27.90 ↓	30.24 ↓	Type B
	ALTAR 84/AO 'S'	2.67 ↓	18.61 ↓	36.21 ↓	
	GAN/A. touschii (WX897)	7.64 ↓	22.59 ↓	28.91 ↓	
	GR'S/Boy'S'	8.31 ↓	26.91 ↓	34.22 ↓	
	Halberd	4.66 ↓	15.96 ↓	30.24 ↓	
	Dharwar Dry	5.98 ↓	27.24 ↓	34.55 ↓	
The maximum quantum yield of PSII	ALTAR 48/ <i>Aegilops tauschii</i> Coss. (WX193)	47.23 ↓	74.46	74.46 ↓	
	ALTAR 84/AO 'S'	0.00	31.86 ↓	78.57 ↓	
	GAN/A. touschii (WX897)	36.87 ↓	60.34 ↓	69.84 ↓	
	GR'S/Boy'S'	5.62 ↓	62.92 ↓	79.23 ↓	
	Halberd	25.00 ↓	32.61 ↓	69.56 ↓	
	Dharwar Dry	45.61 ↓	52.75 ↓	72.53 ↓	

SPAD- soil plant analytical device; PSII- photosystem II, NA- data not available

For raw data – Click here (.xlsx file)

Reference- Pradhan *et al.*, 2012

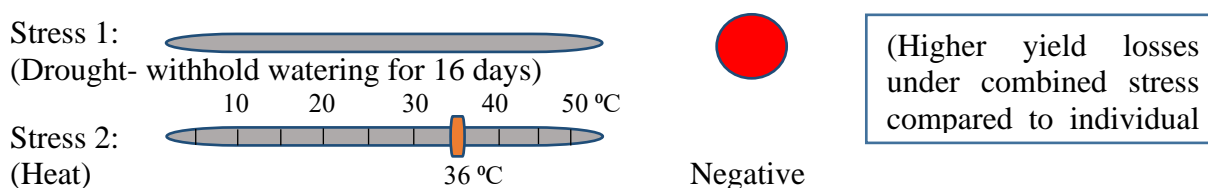
Note: Values presented in the table were calculated using the formula described below.

$$\text{Reduction over control (\%)} = \frac{(\text{Value Control} - \text{Value Stress})}{\text{Value Control}} \times 100$$

- 1) '↓' - indicates plant parameters affected by stress that leads to high susceptibility.
- 2) Control plants maintained at 21/15 °C day/night.

'*' - For more information on parameters classification, please refer to 'methodology' tab.

Bar showing net impact of combined stress over control



Note: The bar is drawn based on 'type B' parameter, i.e., photosynthetic rate. When the cursor dragged, an interaction between two levels of stress shown as a negative outcome (*red*- plants are more affected under combined stress compared to individual stresses) or positive outcome (*green*- plants are less affected under combined stress compared to individual stresses).

The inference from the study: Pradhan *et al.*, 2008 study examined the independent and combined effect of drought and heat stress on yield at anthesis (Experiment-I) and 21 days after anthesis (Experiment-II) stage in four synthetic hexaploid wheat genotype (ALTAR 48/*Aegilops tauschii* Coss. (WX193); ALTAR 84/AO'S'; GAN/A. *touschii* (WX897); GR'S/Boy'S') and two spring cultivars (Halberd & Dharwar Dry). Stress response varied across the genotypes and the stress treatments. All the stress treatments resulted in a reduction in yield, individual grain weight, grain number, leaf chlorophyll content and maximum quantum yield of PSII in both the experiments with higher reduction under experiment-I. Among the stress treatments, combined stress resulted in higher yield losses compared to individual stresses. The average yield reduction in drought, heat and combined stress were 69, 81 and 92% in experiment-I and were 26, 37 and 50% in Experiment-II respectively. Genotypes ALTAR 84/AO 'S' and ALTAR 84/*Aegilops tauschii* Coss. (WX 193) were least affected by combined stress in experiments I and II respectively. **Overall data indicate that combined stress treatment was more detrimental than individual stresses and anthesis stage is more sensitive to stress as shown by wheat genotypes.**