Variation for morpho-physiological and biochemical determinants of drought tolerance in oilseed Brassicas

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INTRODUCTION

Oleiferous Brassicas are mostly cultivated on light textured soils with conserved soil moisture and are frequently subjected to drought stress especially during reproductive growth leading to yield losses in many parts of world. Adequate documentation of genetic variations to water stress is required to cope up with the changing climatic conditions and anthropogenic activities which will further limit water for irrigation in the Southern hemisphere. Genetic variations for moisture tolerance in the *Brassicas* are yet to be adequately documented for breeding drought tolerant varieties.

OBJECTIVE

To assess the genotypic variations for biochemical and physiological determinants of productivity in the canola cultivars of oilseed rape (*B.napus)* and Indian mustard (*B. juncea).*

MATERIAL AND METHODS

Elaborate studies were undertaken in 15 genotypes each of oilseed rape (*B. napus*) and Indian mustard (*B.juncea*) to assess the extent of variability for different traits such as photosynthesis (Pn),water use efficiency (WUE), chlorophyll fluorescence (Fv/Fm), relative water content (RWC), leaf area (LA), canopy temperature, canopy air temperature differential (CATD) and seed yield under moisture stress (only pre-sowing irrigation), restricted moisture (one irrigation at 35 days) and normal irrigation (two irrigations at 35 and 65 DAS) conditions. Mean field capacity of experimental site was 17.8% with available water 14.3cm. The irrigation modules had water equivalence of 155.6mm and 275.6mm, respectively after accounting for cumulative rainfall of 155.6mm.

KEY RESULTS

❖Moisture stress reduced photochemical efficiency of PSII (Fv/Fm), specific leaf weight (SLW), relative water content (RWC), leaf area (LA) in *B .napus* and *B. juncea* to variable extent but osmoprotectants and antioxidative enzymes were higher under stress and were responsible for stress tolerance.

❖Mean canopy temperature was higher but CATD was significantly lower under water deficit.

❖Root length is an important trait for drought tolerance.

❖Rate of photosynthesis and water use efficiency was higher in elite genotypes.

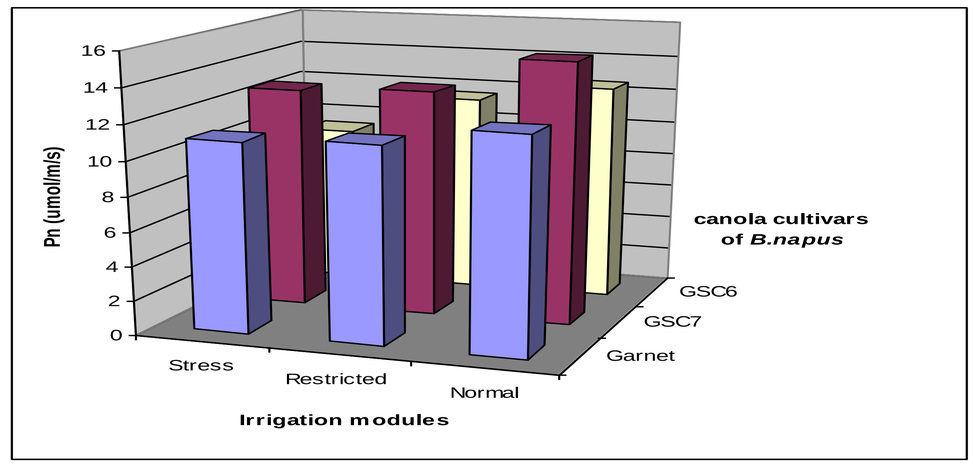
❖Promising genotypes were able to maintain lower temperature due to transpiration cooling.

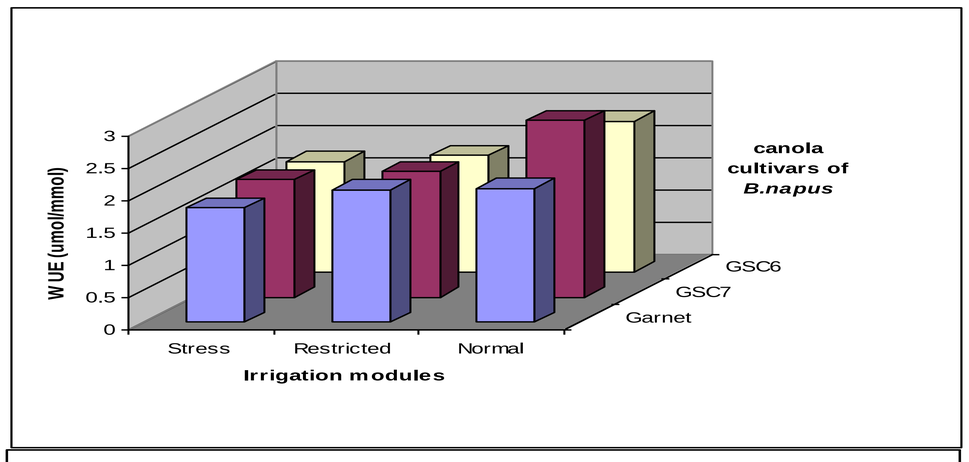
❖Growth and yield components were significantly reduced but minimum decline in the elite genotypes contributed to their relative better performance under moisture deficit.

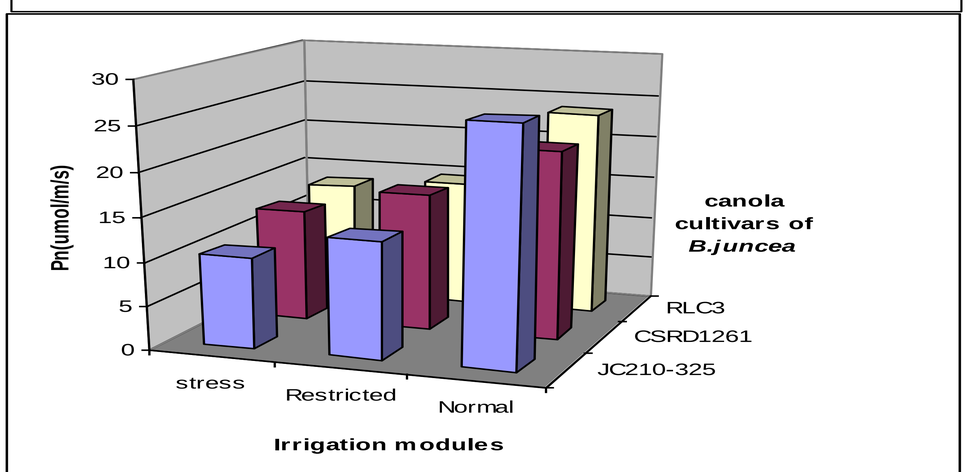
❖Based on morpho-physiological and biochemical traits and drought susceptibility index (DSI) ≤0.5 and drought tolerance index (DTI) ≥0.87, genotypes Garnet, GSC7, GSC6 of *B. napus* and RLC3, JC 210-325 and CSRD-1261 of *B. juncea* were rated tolerant to water deficit.

Table 1. Morpho-physiological and biochemical traits associated with moisture tolerance in canola cultivars

Traits	*B. napus*			*B. juncea*		
	Moisture stress	Restricted moisture	Normal	Moisture stress	Restricted moisture	Normal
Physiological traits						
Specific leaf weight (mg/cm^2)	1.79	2.27	2.92	1.8	2.3	2.8
Canopy temperature (^{0}C)	25.9	24.8	23.5	25.5	24.3	23.2
Canopy air temperature differential (CATD, ^{0}C)	-2.0	-2.7	-2.9	-2.6	-2.8	-3.3
Chlorofluroscence (Fv /Fm)	0.696	0.720	0.738	0.694	0.718	0.728
Relative water content (%)	69	73.3	78	67.8	72.1	75.6
Leaf area (cm^2)	2183	3299	4727	1006	1516	2267
Root length (mm)	675	801	930	516	579	686
Osmoprotectants (mg/g DW)						
Total soluble sugars	27.8	23.2	19.3	56.9	47.5	40.6
Proline	0.515	0.401	0.291	0.691	0.549	0.393
Antioxidative enzymes						
CAT(Δ OD/min/g FW)	102.3	83.2	65.5	116.8	96.2	75.2
SOD (units/min/g FW)	100.2	93.1	76.2	135.5	110.2	86.8
POD(ΔOD/min/g FW)	0.983	0.725	0.668	1.02	0.862	0.65
Seed yield (kg/ha)	1910	2044	2229	1241	1453	1624







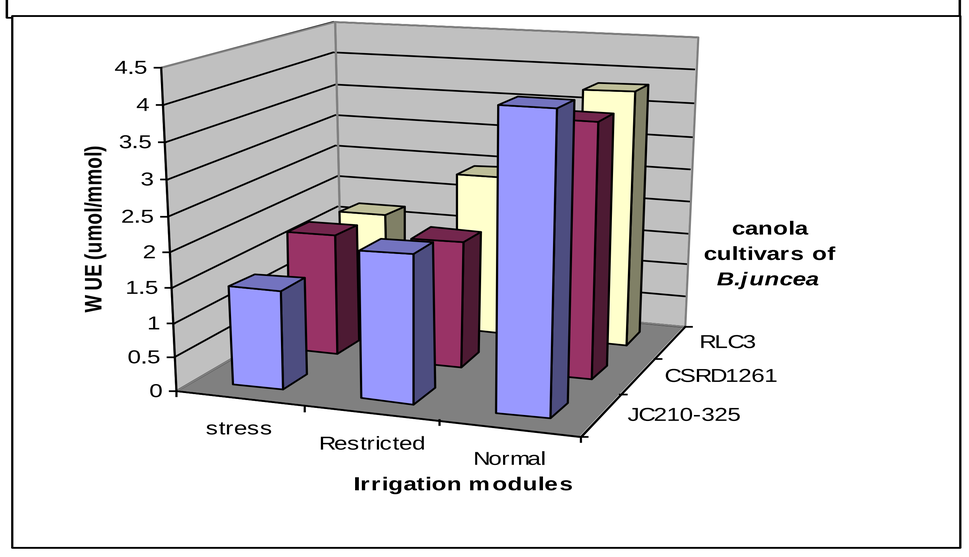


Fig1:Effect of moisture stress on Pn and WUE in elite canola cultivars of *B. napus* and *B.juncea*

CONCLUSIONS

❖ Moisture stress affected the photochemical efficiency (PSII) to greater extent as compared to the other components of chlorophyll fluorescence.

❖ Canola cultivars of oilseed rape (Garnet GSC7 and GSC6) and Indian mustard (JC-21-325, CSRD1261 and RLC3) were found tolerant to moisture stress as they could maintain higher Pn, WUE and lower CATD.

❖ Photosynthesis coupled with chlorophyll fluorescence, RWC, DTI and DSI can be reliable indicators to monitor moisture stress under field conditions.