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Physiological Evaluation of Greengram Genotypes under Moisture Stress Conditions

G Rama Rao, M Deepa, P Latha and M V S Naidu
Department of Plant Physiology, S.V.Agricultural College Tirupathi 517502

ABSTRACT

A field experiment was conducted at Wet land farm of S.V.Agricultural College Tirupathi to study the during late *rabi* 2010-11. The results revealed that significant differences were observed between genotypes, moisture stress and their interaction regarding photosynthetic rate ,transpiration and stomatal conductance in grerngram genotypes .Imposition of moisture stress at flowering stage significantly reduced the photosynthetic rate ,transpiration rate and stomatal conductance was reduced by 23.35%,53.98% and 33.1%when recorded at 45 DAS where as imposition of moisture stress at pod formation and maturity stage it was decreased by 16.05%, 48.55 and 59.4% respectively in greengram genotypes. Among the genotypes tested, MGG357recorded high photosynthetic rate at both stages of stress .WGG37, MGG360, MGG348, and MGG347 recorded moderate photosynthetic rate where as MGG 357 lowest transpiration in both moisture stress, where MGG348was recorded highest transpiration rate in mid stress and MGG360 in end stress treatments. Among the genotypes, LGG460 recorded highest stomatal conductance during stress at flowering where as MGG 360 recorded highest stomatal conductance during pod formation and maturity stage.

Key words : End season moisture stress, Greengram, Mid season moisture stress, Photosynthetic rate, Transpiration rate.

The low productivity of the greengram is attributed to the mid and terminal moisture stress encountered due to irregular or failure of north east monsoon .The effects of drought stress on yield and its components will depend on the stage of development at which water stress occurs. Water stress has been known to influence canopy development, rate of assimilation by canopy and the distribution of assimilates within plants (Turner, 1990) . Plants have developed a number of strategies to cope with the physiological traits associated with drought. Several morphological (Chaves *et al* 2003) and physiological (Nageswarao *et al* 1994) and water use efficiency (Latha 2004) and thermo tolerance traits(Sudhakar *et al* 2006) contributing to drought tolerance were reported . However, such traits in greengram genotypes were less explored. Hence the present investigation was planned to study the genotypic variability for physiological traits in greengram under imposed moisture stress conditions.

MATERIAL AND METHODS

A field experiment was conducted in Wet land farm of S.V.Agricultural College Tirupathi in factorial randomized block design replicated thrice during late *rabi* 2010-11. There are three main treatments ,T_o – adequately irrigated (control) ,T_1 – stress imposed at flowering (30-45DAS) ,T_2 – stress imposed at pod formation and maturity stage (45-60 DAS) and seven sub treatments consists of greengram genotypes (LGG 460, TM 96-2,WGG 37,MGG347,MGG 348,MGG 357,MGG 360).The crop was sown with a spacing of 30x10cm on 7^{th} of January 2011. Recommended dose of fertilizers were applied .The water stress was imposed at flowering stage (30-45 DAS) and pod formation and maturity stage (45-60DAS). Prophylactic measures were taken for protection of crop from diseases and pests. Photosynthetic rate ,transpiration rate and stomatal conductance was measured on all the leaflets of third leaf from the top on main axis at 45 and 60 DAS by using Portable photosynthetic meter with light control (Licor company LI 6400).Seed yield was recorded at maturity.

RESULTS AND DISCUSSION

Significant differences were observed between genotypes, moisture stress and their interactions regarding photosynthetic rate (Table1).Imposition of moisture stress at flowering stage decreased

Table 1. Effect of mid season and end season moisture stress on photosynthetic rate (umol Co_2 m^{-2} sec^{-1}) and transpiration rate (m mol H_2O m^{-2} sec^{-1}) of greengram genotypes. P

Genotypes	Photosynthetic rate at 45DAS				Photosynthetic rate at 60 DAS				Transpiration rate at 45 DAS				Transpiration rate at 60 DAS			
	T_0	T_1	T_2	Mean	T_0	T_1	T_2	Mean	T_0	T_1	T_2	Mean	T_0	T_1	T_2	Mean
LGG 460	17.50	14.50	15.40	15.80	17.40	13.40	15.80	15.53	14.20	3.03	10.60	9.27	11.11	5.69	3.72	6.84
TM 96-2	28.90	24.50	25.30	16.60	23.10	20.10	17.40	20.20	5.14	3.30	7.34	5.26	6.66	10.70	4.66	7.33
WGG 37	20.60	16.20	18.00	18.20	19.40	17.40	14.40	17.06	6.29	4.60	6.94	5.94	5.41	9.46	4.26	6.37
MGG 347	20.10	17.40	18.00	18.50	18.20	16.20	16.30	16.90	6.35	4.80	7.18	6.11	8.63	8.29	3.94	6.95
MGG 348	30.48	20.60	22.00	24.36	23.40	18.60	18.00	20.00	14.20	5.31	10.00	9.83	10.50	9.46	4.18	8.04
MGG 357	28.40	22.40	23.00	24.60	24.40	20.60	18.30	21.10	5.69	2.60	6.79	5.02	6.89	7.86	2.46	5.73
MGG 360	26.70	16.60	23.30	22.20	17.80	16.40	17.70	17.30	7.94	3.91	8.46	6.77	11.90	9.46	4.94	8.76
Mean	24.66	18.90	20.70		20.52	17.52	16.84	-	8.54	3.93	8.18	-	8.98	8.70	4.62	-
C.D at 5%	T	G	TXG	-	T	G	TXG	-	T	G	TXG	-	T	G	TXG	-
	0.82	1.252	2.17		0.076	0.117	0.20		0.088	0.135	0.230	-	0.212	0.325	0.560	-

T_0: Control (Irrigated)

T_1: Moisture stress at flowering

T_2: Moisture stress at pod formation and maturity stage

Table 2. Effect of mid season and end season moisture stress on Stomatal conductance (mol H_20 m^{-2} sec^{-1}) and seed yield of greengram genotypes.

Genotypes	Stomatal conductance at 45 DAS				Stomatal conductance at 60 DAS				Seed yield (kg/ha)			
	T_0	T_1	T_2	Mean	T_0	T_1	T_2	Mean	T_0	T_1	T_2	Mean
LGG 460	0.46	0.21	0.36	0.34	0.29	0.32	0.10	0.23	839	642	516	665
TM 96-2	0.09	0.19	0.24	0.17	0.11	0.49	0.13	0.24	350	538	308	399
WGG 37	0.11	0.19	0.26	0.18	0.11	0.37	0.12	0.20	1435	1138	1016	1202
MGG 347	0.11	0.21	0.30	0.20	0.14	0.41	0.12	0.22	758	728	668	718
MGG 348	0.34	0.24	0.40	0.32	0.19	0.42	0.19	0.26	872	796	893	854
MGG 357	0.14	0.15	0.20	0.16	0.14	0.24	0.20	0.19	1290	1196	1218	1235
MGG 360	0.23	0.20	0.31	0.24	0.37	0.41	0.22	0.33	868	739	876	828
Mean	0.211	0.198	0.296	-	0.193	0.380	0.154	-	916	825	785	-
CD at 5%	T	G	TXG	-	T	G	TXG	-	T	G	TXG	-
	0.0048	0.0048	0.01	-	0.0026	0.004	0.01		11.98	18.3	31.70	

T_0: Control (Irrigated)
T_1: Moisture stress at flowering
T_2: Moisture stress at pod formation and maturity stage

photosynthetic rate by 23.35% recorded at 45 DAS .Due to imposition of moisture stress at pod formation and maturity stage, the photosynthetic rate was declined by 16.05% at 60DAS. Similar results were obtained by Tharaka Ramarao (2002) in cowpea .Among the genotypes tested, MGG 357 recorded high photosynthetic rate at both stages of stress. WGG 37, MGG 360, MGG 348, and MGG 347recorded moderate photosynthetic rate.

Rate of transpiration of greengram genotypes as affected by moisture stress at flowering stage and pod formation and maturity stage are presented in Table 1.Significant differences were observed among genotypes ,moisture stress treatments and their interactions regarding transpiration rate of greengram genotypes. Due to the imposition of moisture stress at flowering stage ,transpiration rate was lowered by 53.94% and at pod formation and maturity stage (45-60DAS) ,the transpiration rate was lowered by 48.5% .Similar results were obtained by Bhagsari (1976) in groundnut. Among the genotypes, MGG357 recorded lowest transpiration in both moisture stress treatments where as MGG348 was recorded highest transpiration rate in mid stress and MGG-360 in end stress treatments.

Significant differences were observed among genotypes and moisture stress treatments regarding stomatal conductance (Table 2).Due to imposition of moisture stress at flowering and pod formation and maturity ,stomatal conductance was reduced by 33.1% and 59.4% respectively .These results were inconformity with the report in groundnut by Black (1985). Among the genotypes tested , LGG 460 recorded highest stomatal conductance during stress at flowering ,where as MGG360 recorded highest stomatal conductance during stress at pod formation and maturity stage .It is note worthyMGG357 recorded lowest stomatal conductance at both the stages of stress however it maintained moderate photosynthetic rate .

Significant differences were noticed between moisture stress treatments ,genotypes and their interactions regarding seed yield (Table 2).Due to imposition of moisture stress at flowering stage and pod formation and maturity stage ,seed yield was significantly reduced compared to irrigated control ,the possible decrease in stomatal conductance and leaf area resulting in loss drymatter accumulation partly explains the decrease in yield and yield components under moisture stress (Ramana rao ,1994) Due to the imposition of moisture stress at flowering and pod formation and maturity stage ,mean seed yield was significantly decreased .The extent of decrease was less pronounced at flowering (9.92%) compared to pod formation and maturity stage (14.3%) when compared to irrigated control. These results are in conformity with the findings of Sudhakar *et al* (2006) in blackgram.

The genotypes MGG 357 and WGG 37 also maintained highest mean seed yield of 1235 kg ha^{-1} and 1202 kg ha^{-1} respectively compared to other genotypes. However, under stress conditions yield reduction was more in WGG 37 (20% in mid stress, 5.63% end stress) ,MGG 348 ,MGG 360 and MGG 347 recorded moderate seed yield, where as LGG 460 and TM 96-2 recorded lower seed yield.

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