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Effect of Mid and End Season Moisture Stress on Growth, Drymatter Production and Yield in Greengram Genotypes

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ABSTRACT

A field experiment was conducted during *rabi* 2010-11 at wet land farm of S.V. Agricultural college Tirupithi to study the effect of mid and end season moisture stress on growth, drymatter production and yield in greengram genotype. Results revealed that significant differences were observed between moisture stress treatments, genotypes and their interaction with regard to the plant height, days to 50% flowering, leaf area, root, leaf, stem, pod, and total drymatter production and yield and yield components. Among the genotypes, WGG-37 and MGG-357maintained high leaf area, drymatter accurlation, yield and yield components under irrigated and moisture stress conditions. Plant height and days to 50% flowering were more affected due to mid stress compared to end stress (45-60 DAS). Whereas the effect of end stress on leaf area and dry matter production and it partitioning, yield and yield components was more accute compared to mid stress (stress imposed at 30-45DAS).

Key words: Drymatter, End season moisture stress, Greengram, Mid season moisture stress, Yield.

In Andhra Pradesh, green gram occupies an area of 0-55 m.ha with the productivity of 0.61 tons and with the productivity of 355Kg. ha^{-1} (WWW.J.kisan.com 2009-2010). The crop is well suited in cropping systems as a mixed crop, catch crop, sequential crop besides growing as a sole crop under residual moisture conditions. 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. Water stress has been known to influence canopy development, rate of assimilation by canopy and the distribution of assimilates within plants. Moisture stress at flowering and podding stage is most common in southern zone of A.P and reported to reduce the yield and harvest index significantly. Under such situation, identification of genotypes with higher drymatter, WUE and seed yield is necessary for growing under rainfed conditions. Several morphological (Chaves *et al* 2003) and physiological traits (Wright and rao 1992) contributing to droght tolerance were reported. However, such traits in greengram genotypes were less explored. Hence, the present investigation was taken up to study the effect of mid and end season moisture stress on growth, drymatter and yield of greengram genotypes.

MATERIAL AND METHODS

A field experiment was conducted at wet land farm of S.V.Agricultural college, Tirupathi during *rabi* season 2010-2011. The experiment was laid out in sandy loam soil in a randomized block design with factorial concept with three treatments and seven genotypes and replicated thrice. Main treatments consists of To-No stress (control),T1-moisture stress imposed at flowering stage (30-45DAS), T2- moisture stress imposed at pod formation and maturity stage (45-60 DAS). The sub treatments consist of 7 greengram genotypes (G1:LGG-460, G2:TM96-2, G3: WGG 37, G4: MGG-347, G5: MGG-348, G6: MGG-357, G7: MGG-360). The seed material was obtained from RARS, lam, Guntur, and Warangal. Seeds were sown in lines by dibbling 2 seeds per hill with a spacing of 30 X 10 cm on 7th January 2011. Thinning and gap filling was done within 10 days after sowing to maintain uniform plant stand in all the treatments. The crop was grown following the recommended package of practices and timely plant protection measures were also adopted. Sampling was done at 10 days interval. For this purpose three plants from each treatment or each plot were dug out along with roots and separated into leaf, stem, root, pod and dried at 80 ^{0}c temperature in a hot air oven until constant weight was attained. The dry weight of leaf, stem, root, pod and total drymatter of the plant was recorded separately. The yield and yield components were recorded at harvest time. The data were analyzed statistically by following standard procedure outlined by Panes and sukhot me (1967).

Table 1. Effect of mid and end season moisture stress on growth of greengram genotypes at maturity

Treatment	Plant height (cm)				Days to 50% flowering				Leaf area (Cm^2 $Plant^{-1}$)				Root drymatter (g $plan^{-1}$)			
	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	36.0	25.4	29.5	30.3	39.3	36.2	40.3	38.3	270	224	211	235	0.54	0.42	0.40	0.45
TM 96-2	27.5	23.1	28.9	26.5	40.3	36.4	40.4	39.0	260	260	176	232	0.51	0.48	0.43	0.47
WGG-37	45.0	34.3	45.5	41.6	34.1	30.7	35.7	33.5	382	295	200	292	0.77	0.70	0.72	0.73
MGG-347	24.8	22.3	26.1	24.4	37.9	35.0	37.4	36.7	269	210	161	213	0.57	0.52	0.49	0.62
MGG-348	37.3	36.5	35.8	36.5	37.0	33.4	37.4	35.9	278	203	189	224	0.59	0.54	0.50	0.55
MGG-357	36.8	27.6	37.7	34.0	34.4	34.6	34.4	34.4	345	300	270	305	0.89	0.79	0.74	0.81
MGG-360	37.3	33.6	36.9	35.9	38.0	34.2	40.6	37.6	319	280	184	261	0.50	0.40	0.40	0.43
Mean	35.0	29.0	34.3	-	37.2	34.3	38.0	-					0.062	0.55	0.53	-
	T	G	TXG		T	G	TXG		T	G	TXG		T	G	TXG	
CD at 5%	2.9	4.44	NS		0.06	0.10	0.18		0.010	0.016	0.028		0.0014	0.002	0.003	

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

Table 2. Effect of mid and end season moisture stress on drymatter production of greengram genotypes at maturity.

Treatment	Leaf drymatter (g plant^{-1})				Stem drymatter (g plant^{-1})				Pod drymatter (g plant^{-1})				Total drymatter (g plant^{-1})			
	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	4.29	4.1	3.88	4.07	3.18	2.85	2.65	2.89	6.74	5.52	4.65	5.63	14.70	12.88	11.58	13.05
TM 96-2	3.72	3.51	3.05	3.42	3.20	2.75	2.75	2.90	6.50	5.08	5.02	5.33	13.93	11.82	11.25	12.30
WGG-37	5.30	4.92	4.50	4.90	4.60	4.10	3.88	4.19	10.57	8.45	8.36	9.12	21.24	18.17	17.46	18.95
MGG-347	4.50	4.25	3.74	4.16	3.96	3.53	3.11	3.53	8.00	6.16	6.13	6.76	17.03	14.28	13.47	14.92
MGG-348	5.00	4.40	4.30	4.56	3.85	3.51	3.28	3.54	8.63	7.09	6.23	7.31	18.07	15.54	16.30	16.63
MGG-357	5.30	4.96	4.50	4.92	4.50	4.02	3.78	4.10	10.60	8.85	8.22	9.22	21.29	18.62	17.24	19.05
MGG-360	5.04	4.52	4.12	4.56	4.05	2.90	2.74	3.23	8.48	6.67	6.50	7.21	18.07	14.19	13.76	15.44
Mean	4.7	4.37	4.01	-	3.90	3.35	3.17	-	8.50	6.83	6.44	-	17.61	15.11	14.42	-
	T	G	TXG		T	G	TXG		T	G	TXG		T	G	TXG	
CD at 5%	0.030	0.047	0.081		0.009	0.013	0.024		0.08	0.13	0.22		0.160	0.244	0.423	

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

Table 3. Effect of mid and end season moisture stress on yield and yield components of greengram genotypes .

Treatment	No. pods plant^{-1}				No.of seeds pod^{-1}				Pod length (cm)				Seed yield (kg ha^{-1})			
	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	13.0	11.80	12.70	12.50	10.90	10.60	10.50	10.60	7.80	6.80	6.80	7.13	839	642	516	665
TM 96-2	12.40	10.10	11.10	11.20	10.40	8.40	10.20	9.66	7.10	6.70	5.50	6.43	350	538	308	399
WGG-37	18.40	16.00	14.40	16.16	13.00	11.10	10.50	11.53	8.70	7.20	7.40	7.76	1435	1138	1016	1202
MGG-347	14.20	11.20	11.30	12.23	10.60	9.60	8.00	9.40	7.30	5.70	5.50	6.16	758	728	668	718
MGG-348	16.20	14.60	13.90	14.90	11.40	11.10	10.20	10.90	7.90	7.10	7.10	7.36	872	796	893	854
MGG-357	17.40	15.20	14.90	15.83	12.10	12.00	11.00	11.70	8.10	7.40	7.30	7.60	1290	1196	1218	1235
MGG-360	15.00	14.00	13.00	14.00	11.00	10.60	10.00	10.53	7.60	6.90	6.90	7.13	868	739	876	828
Mean	15.18	13.27	13.04	-	11.34	10.61	10.05	-	7.78	6.82	6.64	-	916	825	785	-
	T	G	TXG		T	G	TXG		T	G	TXG		T	G	T X G	
CD at 5%	0.13	0.36	0.20		0.03	0.09	0.05		0.21	0.32	0.57		11.9	18.3	31.7	

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

RESULTS AND DISCUSSION

Significant differences were observed between moisture stress treatments and genotypes throughout the crop growth for plant height (Table 1). Moisture stress imposed flowering stage (30-45DAS) decreased mean plant height at significantly compared to pod formation and maturity stage (45-60DAS). These results denote that moisture stress before 50 DAS is detrimental with respect to plant height. Similar significant differences between genotypes and treatment were also reported in chickpea (Hossein *et al* 2009). The tested genotypes were also significantly varied for mean plant height. Among the genotypes WGG-37 recorded highest mean plant height followed by MGG-360, MGG-348, MGG-357, and LGG-460 recorded moderate plant height , whereas TM96-2 and MGG-347 recorded lowest plant height. Interaction effects were non significant. Genotypic variability in plant height due to moisture stress was also reported in chickpea (Husseini *et al* 2009).

Significant differences were noticed between moisture stress treatments, genotypes and their interaction with respect to days to 50% flowering. The moisture stress at flowering (30-45 DAS) significantly reduced the number days to 50% flowering compared to irrigated treatment and end stress (45-60 DAS). The moisture stress at 30 DAS advanced 50% flowering by 3 days compared to irrigated treatment. Similar results of derease in days to 50% flowering was also reported in greengram by Alsuhaibani (2009) and Ahmed etal (2004). Among the genotypes tested, WGG-37 proved to be early (34.16 days) followed by MGG-357(35.8 days). LGG-460 (39.26 days) and TM 96-2 (39.7 days) proved to be late flowering types. Earliness in flowering by the genotype MGG-357 was well supported by its emerging index (36.63). Similarly TM 96-2 which recorded lowest emergence (31.30) showed delayed flowering accordingly. Such genotypic differences in days to 50% flowering was also reported by Gosami *et al*. (2010) in greengram and Shinde *et al.* (2010) in pigeonpea.

There was a significant differences between the moisture stress treatments and genotypes with regard to leaf area (Table 1). Imposition of moisture stress at flowering stage (30-45 DAS) decreased leaf area to the extent of 16.5% compared to moisture stress at 45-60 DAS (34.5%) due to foster senesence and higher leaf drop. Such decrease in leaf area due to moisture stress was also reported in chickpea (Lutfor Rahman, 2000) greengram (Naidu *et al* 2001) and in groundnut (Latha,2004). Among the genotypes, WGG-37 recorded highest leaf area both under inigated as well as stress conditions followed by MGG-357, MGG-348, MGG-360, LGG-460 and MGG-347 recorded moderate leaf area where as TM 96-2 recorded significantly lowest leaf area. The genotypes WGG 37 and MGG-357 maintained higher drymatter accumulation probably due to higher photosynthesizing area.

Significant differences were observed between, treatments and their interaction with regard to root drymatter (Table 1). Imposition of stress at flowering (30-45 DAS) and pod root dry weight. The extent of decrease was more pronounced at mid stress (28.8%) compared to end stress (11.8%) which denotes the root growth is active upto flowering stage and moisture stress stage during the period is more sensitive compared to post flowering pheno phase. Similar significant differences were observed in grain legume by Taraka Rama Rao(2002). Among the genotypes, MGG-357 recorded high root biomass followed WGG-37, denoting higher drought tolerance, where as TM 96-2 recorded low root biomass compared to other genotypes. Boyer *et al* (1975) reported that drought tolerant cultivars with higher yield showed to high root densities compared to low yields.

There was a significant differences between genotypes treatment and their interactions with regard to shoot, leaf, and pod drymatter(Table 2). Imposition of stress at flowering stress (30-45 DAS) and pod filling and maturity stage (45-60 DAS), significantly decreased short leaf and pod dry weight. The extent of decrease was more pronounced at mid stress (27.8%, 28%, 18.8%) compared to end stress (16.6%, 15.74%, 15.68%) in shoot, leaf, and pod respectively. Such significant differences were observed in grain legumes by Taraka Rama Rao (2002) and in chichpea by Hosseini (2009). Among the genotypes, WGG 37 and MGG-357 recorded high shoot, leaf and pod drymatter where as TM 96-2 recorded low shoot, leaf, pod drymatter compared to other genotypes. These results indicates the drymatter partition abilities of genotypes, which is an important character in pulse crops.

Drymatter accumulation and distribution is an important factor indicating partitioning efficiency of a genotype. In general soil moisture determines the accumulation of drymatter in different plant parts. Significant differences were observed between moisture stress treatments genotypes and their interactions regarding total drymatter (Table 2). Imposition of moisture stress at pod formation and maturity stage significantly decreased the total dry matter compared to moisture stress at flowering stage. This is due to significant reduction in pod drymatter. Similar reduction in dryweight due to terminal moisture stress was also reported in groundnut by Samsukumar (1991). Among the genotypes, WGG-37 and MGG-357 recorded highest drymatter both under inigated as well as moisture stress conditions compared to other genotypes. LGG-460, MGG-358, MGG-347 and MGG-360 recorded moderate dryweights, where as TM 96-2 recorded lowest total drymatter accumulation. The high biomass genotypes WGG-37 and MGG-357 also maintained higher photosynthesizing area (leaf area) during crop growth period, irrespective of treatments. Wright and Rao (1992) reported that cultivars with varies early growth, a relatively large biomass accumulation and capacity for remobilizing stored assimilates to reproductive sinks may be better adopted to drought stress.

Significant differences were noticed between moisture stress treatments, genotypes and their interaction with regards to number of pods for plant, pod length, Number of seeds per pod and seed yield (Table 3). The yield and yield component were significantly reduced due to imposition of moisture stress at both flowering and pod formation and maturity stages. Imposition of moisture stress at pod formation and seed filling stage showed higher reduction in number of pods (14.1%), number of seeds per pod (9.1 %) pod length (14.65 %) and seed yield (14.3%) compared to flowering stage (12.6%, 3.6%,12.3%, 9.92%) respectively. These results were in conformities with reports in chickpea by Lufter Rahman et al. 2000). These results clearly indicates that moisture stress during sensitive growth stages i.e flowering and pod filling stages are deter mental to pod growth and the effect was more pronounced at terminal stress.

The genotypes MGG-357 and WGG-37 maintained higher seed yield of 1235 Kg ha^{-1} and 1202 Kg ha^{-1} respectively compared to other genotypes. MGG-348, MGG-360 and MGG-347 recorded moderate seed yield, where as LGG-460 and TM 96-2 recorded lowest seed yield similar to pod yield. The genotypes MGG-357 and WGG-37 recorded highest drymatter, leaf area, number of pods per plants, seed per plant, pod length and harvest index thus maintained higher seed yields under irrigated as well as moisture stress condition. These results revealed that both MGG-357 and WGG-37 are highly suitable to the southern zone under both irrigated as well as rainfed condition.

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