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Research Article

EFFECT OF WATERLOGGING ON GROWTH AND SEED YIELD IN GREENGRAM GENOTYPES

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ABSTRACT
A filed experiment was conducted during *rabi* 2012-13 to study the effect of water logging on growth and seed yield of greengram genotypes at Agricultural college farm, Bapatla. The results revealed that significant difference were observed between waterlogging treatments and genotypes. The growth parameters such as plant height, number of leaves, leaf area, total drymatter measured at different intervals were significantly affected by waterlogging. The effect of four days waterlogging was more acute compared to two days waterlogging treatment over the control. Imposing four days waterlogging resulted in decrease in plant height (33.17%), number of branches (33.85%), number of leaves (30.74%), leaf area(30.59%) ,total drymatter(30.27%) and seed yield (70.5%) over control. TM 96-2 maintained higher values of all the above parameter followed by LGG 460 whereas LGG 407 recorded lowest values of all the above parameters.

Keywords: *Drymatter, Growth, Seed Yield, Waterlogging*

INTRODUCTION
Green ram is an important short duration pulse crop having wider adaptability and low input requirements. In Andhra Pradesh it occupies an area of 4.4 lakh ha with the production of 2.17 lakh tons and with the productivity of 493.18 Kg ha^{-1}(Agropedia. iit. ac. in 2011-12). Waterlogging is a serious problem, which effects the crop growth and yield. Water logging blocks the oxygen supply to the roots thus inhibiting root respiration, resulting in severe decline in energy status of root cells affecting important metabolic process of plants. Water logging in peanut deceased the nodule number, dry matter, chlorophyll content and pod yield (Krishnamoorthy *et al.,* 1980).Ahmed *et al.,* (2002) reported that waterlogging in mungbean plants caused a fast decline in the photosynthetic rate, transpiration rate, leaf water potential, drymatter and seed yield. Keeping in this view, it has been proposed to investigate the effect of water logging on growth and seed yield of greengram.

MATERIALS AND METHODS
A field experiment was conducted at College Farm, Agricultural College, Bapatla during *rabi* 2012-13. The experiment was laid out in sandy clay loam soil in a split plot design with five genotypes, three treatments and replicated thrice. Treatments consist of waterlogging treatments as main plots W_0- Control (No waterlogging), W_1- Waterlogging for 2 days (at vegetative stage 21DAS), W_2-Waterlogging for 4 days (at vegetative stage 21DAS) and genotypes as subplots (LGG460, LGG450, LGG486, TM96-2, LGG407). Seed material was obtained from RARAS, Lam Guntur and sown with a spacing of 30cmx10cm with a plot size of 4mx3m. Five green gram genotypes were exposed to waterlogging condition (5cm) for two days for one treatment and four days for another treatment at vegetative stage. The data on plant height, number of branches, leaves, drymatter were taken at different time intervals and yield and yield components were recorded at harvest time.

RESULTS AND DISCUSSION
The plant height and number of branches gradually increased from 25 to 65 DAS, Significant differences were observed between waterlogging treatments and genotypes, throughout the crop growth for plant height and number of branches (Table 1). Imposition of waterlogging for two days and four days were significantly reduced the plant height and number of branches at all stages of plant growth. At maturity,

control plants showed highest plant height (54.36cm) and number of branches (12.06), where as four days waterlogging showed shortest plants (41.13cm) and less number of branches (9.01). Waterlogging for two days was found less detrimental to the plant height and number of branches as compared to waterlogging for four days. Four days waterlogging decreased the plant height and number of branches (32.17 and 33.85percent) and two days waterlogging decreased the plant height and number of branches 14.73 and 20.35 percent over the control. Reduction in plant height and number of branches in waterlogging treatment was mainly due to oxygen deficiency, anaerobic conditions, less root activity, impairment of water absorbing ability of the plants or inhibition of synthesis and transport of photosynthetic assimilates (Wample and Thorton, 1984). Similar results were also reported in gram (Krishnamoorthy *et al.,* 1987).

The genotypes tested for waterlogging tolerance were also significantly varied for plant height and number of branches at all stages. Among the genotypes tested TM 96-2 recorded highest plant height and number of branches followed by LGG 460 and the lowest plant height and number of branches was recorded by LGG 407 and the remaining genotypes LGG 450, LGG 486 were on par with each other. Highest plant height and number of branches in TM 96-2 was due to higher SCMR values, higher leaf area, higher total drymatter, higher LAI, and leaf growth and due to quick recovery of photosynthesis after waterlogging, higher photosynthetic rate as reflected through the total drymatter (Ahmed *et al.,* 2002). Similar differences in genotypes were also observed in greengram by Yadav and Saxena (1998) and in maize by Saritha and Singh (2002).

Significant differences were observed between waterlogging treatments and genotypes with regards to number of leaves and leaf area (Table 1& 2). The number of leaves and leaf area gradually increased from 25 to 55 DAS and then declined in all genotypes irrespective of treatments. Imposition of waterlogging for two days and four days significantly reduced the number of leaves and leaf area at all stages of plant growth. Control plants showed highest number of leaves and leaf area at all stages of plant growth. Waterlogging for two days was found less detrimental to the number of leaves and leaf area compared to waterlogging for four days. From 55 DAS onwards, the leaf area declined due to senescence of leaves. Waterlogging for two days decreased the number of leaves and leaf area by 20.91 and 14.54 percent and waterlogging for four days decreased the number of leaves and leaf area by 30.74 and 30.59 percent over control. Reduction in number of leaves and leaf area in waterlogging treatment was due to oxygen deficiency, anaerobic conditions, less root activity, impairment of water absorbing ability of the plants or inhibition of synthesis and transport of photosynthetic assimilates (Wample and Thorton, 1984). Similar results were also reported in soybean by Sorte *et al.,* (1995).

The genotypes tested for waterlogging tolerance varied significantly for number of leaves and leaf area at all stages. Among the genotypes tested TM 96-2 recorded highest number of leaves and leaf area followed by LGG 460 and the lowest number of leaves and leaf area was recorded by LGG 407 and the remaining genotypes LGG 450, LGG 486 were on par with each other. Highest number of leaves and leaf area in TM 96-2 was recorded due to higher SCMR values, plant height, leaves, branches, higher leaf area and rate of photosynthesis (Ahmed *et al.,* 2002). Similar differences in genotypes were also observed in greengram by Yadav and Saxena (1998) and in maize by Saritha and Singh (2002).

Drymatter accumulation and distribution is an important factor indicating partitioning efficiency of a genotype. The data indicated that irrespective of the treatments, there was a two fold increase in total plant dryweight between 45-55 DAS and there after the increase was only relative in all the genotypes as the crop reached maturity (Table 2). Drymatter decreased significantly with increasing the extent of waterlogging at all growth stages. Drymatter was found to be reduced drastically with four days waterlogging. Two days waterlogging decreased the total drymatter by 12.36 percent and four days waterlogging decreased the total drymatter by 30.27 percent over the control and 15.94 percent decrease over two days waterlogging. Reduction in total drymatter was largely due to the impairment of water absorbing ability of the plants as indicated by the reduction in leaf turgidity as well as translocation of drymatter from the pods to the seeds possibly due to damage caused to the root system. Such inhibition may also be due to adverse effects of waterlogging on water and mineral uptake (Hocking *et al.,* 1987). Similar results were also reported in greengram (Jafar, 2006a) in pigeonpea (Takele and Mcdavid, 1995).

Table 1: Effect of waterlogging on growth of greengram genotypes

Treatments	**Plant height (cm)**					**Number of branches**					**Number of leaves**				
Waterlogging levels	**25 DAS**	**35 DAS**	**45 DAS**	**55 DAS**	**65 DAS**	**25 DAS**	**35 DAS**	**45 DAS**	**55 DAS**	**65 DAS**	**25 DAS**	**35 DAS**	**45 DAS**	**55 DAS**	**65 DAS**
Control (W_0)	28.90	44.88	49.65	52.52	54.36	1.17	4.85	6.95	10.21	12.06	14.48	19.99	22.73	25.73	23.31
Two days (W_1)	26.88	39.74	43.03	44.62	47.38	0.95	4.36	5.38	6.69	10.02	13.37	17.85	19.53	21.28	20.76
Four days (W_2)	23.22	34.02	37.22	40.03	41.13	0.84	3.80	4.30	5.40	9.01	11.60	16.01	17.33	19.68	18.31
CD (P=0.05)	0.93	4.06	1.86	1.46	0.60	0.19	0.20	0.86	0.34	0.67	0.63	0.73	1.85	0.74	1.43
Genotypes															
LGG 460 (V_1)	26.72	40.34	43.83	46.37	50.02	1.02	4.44	5.72	7.62	10.46	13.27	18.29	20.04	22.02	22.11
LGG 450 (V_2)	25.70	38.30	42.48	44.96	46.09	0.93	4.16	5.29	7.11	10.02	12.91	17.38	19.56	21.27	21.00
LGG 486 (V_3)	26.04	39.05	43.26	45.54	47.34	1.00	4.21	5.31	7.24	10.18	13.13	18.07	19.87	21.96	21.27
TM 96-2 (V_4)	28.34	43.40	45.55	47.77	52.04	1.09	4.89	6.53	8.27	11.30	14.02	19.18	21.56	24.02	23.04
LGG 407 (V_5)	24.87	36.66	41.38	43.97	45.96	0.89	3.99	4.87	6.93	9.87	12.42	16.84	18.31	20.60	19.49
CD (P=0.05)	1.32	2.90	1.62	1.27	1.73	NS	0.43	0.78	0.53	0.81	0.66	0.88	1.34	0.95	0.81
Interaction	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 2: Effect of waterlogging on growth, yield and yield components in greengram genotypes

Treatments	Leaf area (Cm^2 $plant^{-1}$)					**Total drymatter (g $plant^{-1}$)**					**Seed yield (Kg ha^{-1})**	**Number of pods/plant**	**Number of seeds/pod**	**100 seed weight (g)**	**HI (%)**
	25 DAS	**35 DAS**	**45 DAS**	**55 DAS**	**65 DAS**	**25 DAS**	**35 DAS**	**45 DAS**	**55 DAS**	**65 DAS**					
Waterlogging Levels															
Control (W_0)	202.04	319.64	515.05	570.13	419.11	0.88	1.90	4.89	10.04	13.73	982.71	20.93	11.14	3.74	40.82
Two days (W_1)	183.18	304.81	452.35	497.77	385.63	0.72	1.66	3.74	8.65	12.22	787.36	16.40	9.78	3.70	36.27
Four days (W_2)	156.22	230.44	415.92	436.59	371.01	0.61	1.37	2.83	6.94	10.54	576.31	12.93	8.74	3.64	30.59
CD (P=0.05)	18.10	30.14	30.40	61.20	NS	0.07	0.17	0.43	0.38	0.50	74.77	1.88	0.61	0.01	1.92
Genotypes															
LGG 460 (V_1)	178.87	291.52	475.76	508.56	393.72	0.74	1.62	3.81	8.70	12.54	821.33	18.44	10.00	3.93	37.18
LGG 450 (V_2)	174.41	281.09	445.84	501.47	384.34	0.71	1.56	3.68	8.15	12.18	627.52	16.00	9.52	3.58	35.40
LGG 486 (V_3)	175.61	286.41	454.22	506.14	391.98	0.73	1.58	3.79	8.27	12.48	793.11	17.89	9.88	3.59	36.73
TM 96-2 (V_4)	209.08	336.11	513.31	567.96	421.44	0.81	1.92	4.29	9.68	13.33	963.85	22.67	11.00	3.95	40.52
LGG 407 (V_5)	164.44	229.69	416.40	445.04	368.11	0.69	1.52	3.55	7.93	11.96	603.15	15.11	8.83	3.52	32.62
CD (P=0.05)	14.38	40.77	37.43	54.38	25.26	0.05	0.25	0.46	1.10	0.63	131.70	1.91	0.86	0.01	2.77
Interaction	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

The genotypes tested for waterlogging tolerance varied significantly for total drymatter at all stages. Among the genotypes tested TM 96-2 recorded highest drymatter followed by LGG 460 and the lowest drymatter was recorded by LGG 407 and the remaining genotypes LGG 450, LGG 486 were on par with each other. Highest drymatter in TM 96-2 was recorded due to higher SCMR values, leaf area, LAI, rate of photosynthesis (Ahmed *et al.*, 2002). Similar differences in genotypes were also observed in greengram by Yadav and Saxena (1998).

Significant differences were observed between the genotypes and waterlogging treatments with regards to number of pods per plant, number of seeds per pod, 100 seed weight, harvest index and seed yield (Table 2). Imposition of waterlogging for two days and four days were significantly reduced the yield and yield components. Four days waterlogging decreased the number of pods per plant by 50.52 percent, number of seeds per pod (26.85%), 100 seed weight (2.75%), harvest index (33.44%) and seed yield (70.51%) and two days waterlogging decreased 27.62, 13.91, 1.08, 12.54, 24.81 percent respectively over the control. Reduction in seed yield and yield components in waterlogging treatment was due to oxygen deficiency and anaerobic conditions and less root activity, the impairment of water absorbing ability of the plants as indicated by the reduction in leaf turgidity as well as translocation of drymatter from the pods to the seeds possibly due to damage caused to the root system (Wample and Thorton, 1984). Similar results were also reported in greengram (Kumar *et al.,* 2013) and in peas (Belford *et al.*, 1980).

The genotypes tested for waterlogging tolerance were also significantly varied for seed yield. Among the genotypes tested TM 96-2 recorded highest seed yield and yield components followed by LGG 460 and the lowest seed yield was recorded by LGG 407 and the remaining genotypes LGG 450, LGG 486 were on par with each other. Similar differences in genotypes were also observed in greengram (Laosuwan *et al.*, 1994; Yadav and Saxena 1998). Highest seed yield in TM 96-2 was recorded due to higher leaf area, higher total drymatter, higher LAI, higher rate of photosynthesis and leaf growth and due to quick recovery of photosynthesis after waterlogging, higher photosynthetic rate as reflected through the total drymatter (Ahmad *et al.*, 2002). From these results it can be concluded that four days waterlogging was more detrimental compared to two days waterlogging in greengram. Among the genotypes TM 96-2 recorded higher growth and seed yield under waterlogging conditions.

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