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G Rama Rao
RRU Crop Physiology, Regional Agricultural Research Station, Lam Guntur, Acharya NG Ranga Agricultural University ANGRAU, Andhra Pradesh, India

J Satishbabu
RRU Crop Physiology, Regional Agricultural Research Station, Lam Guntur, Acharya NG Ranga Agricultural University ANGRAU, Andhra Pradesh, India

P Ratna Prasad
RRU Crop Physiology, Regional Agricultural Research Station, Lam Guntur, Acharya NG Ranga Agricultural University ANGRAU, Andhra Pradesh, India

Correspondence
G Rama Rao
RRU Crop Physiology, Regional Agricultural Research Station, Lam Guntur, Acharya NG Ranga Agricultural University ANGRAU, Andhra Pradesh, India

Physiological evaluation of Kabuli and desi genotypes of chickpea for drought tolerance under receding soil moisture conditions

G Rama Rao, J Satishbabu and P Ratna Prasad

Abstract
A field experiment was conducted during Rabi 2017-18 at RARS Lam Guntur to study the physiological evaluation of kabuli and desi genotypes of chickpea for drought tolerance under receding soil moisture conditions. The experiment was laid out in a Randomized block design with 12 chickpea genotypes and replicated thrice. The results revealed that significant differences were observed among the chickpea genotypes for drymatter production and partioning in root, stem, leaf, pod, total drymatter, chlorophyll a,b, total chlorophyll, SPAD Chlorophyll meter reading (SCMR), Relative water content (RWC), Chlorophyll stability index, seed yield and yield components. Among the genotypes tested, NBeg 47 recorded higher drymatter production and partitioning in root, stem, leaf, pod, total drymatter, chlorophyll a, b, total chlorophyll, SPAD Chlorophyll meter reading (SCMR), Relative water content (RWC), Chlorophyll stability index, seed yield and yield components followed by NBeg 49, NBeg 399 whereas lower values were recorded in N-119.Maximum seed yield was recorded in NBeg 47 (3250 kg/ha) followed by NBeg 49 (3229 kg/ha) whereas minimum seed yield was recorded in N-119 (2013 kg/ha).

Keywords: Chickpea, chlorophyll content, chlorophyll stability index, Drymatter partioning, Relative water content, Seed yield, SPAD Chlorophyll Meter Reading (SCMR)

Introduction
Grain legumes constitute important components of drought prone agriculture. Water stress reduces the yield of grain legumes remarkable (Parab1991) [5]. Among the different legumes, chickpea is highly acceptable crop in winter season crop in drought prone area of nation as well as world on receding soil moisture conditions. In Andhra Pradesh the area under chickpea is 5.24 Lakh ha with a productivity 1112 kg/ha and production 5.87 lakh tones. The crop is frequently subjected to mid-season stress or terminal moisture stress resulting in low yields. Drought is the single most important abiotic constraints limiting the chickpea production.

Soil moisture stress is a major hazard to successful crop production throughout the world. It reduces the productivity by delay or prevention of crop establishment, alteration of physiological and biochemical metabolism in plant and quality of grain, forage and oil and other economically important products. Moisture deficit affects seed germination and its establishment in the field, photosynthetic ability of the plants and osmotic behavior of cells. However, species and genotypes vary in their capacity to tolerate water stress. The improvement in the genotypes is the only alternative for yield stability under water stress environment. In Andhra Pradesh mostly in Praksam district farmers are facing the drought situation for growing of bengalgram. Therefore, the improved chickpea genotypes with better water use efficiency and higher yield will be suitable for cultivation in drought prone areas and can prove a boon to improve the economic status of poor farmers. of dry land area. Relative water content, SCMR, CSI, parameters has good positive relationship with drought tolerance (Rao *et al.* 2012) [8]. to achieve this, an understanding of physiological process associated with drought tolerance is prerequisite. Therefore the study was undertaken with the objective of physiological evaluation of kabuli and desi genotypes of chickpea for drought tolerance under receding soil moisture conditions.

Materials and Methods
A field experiment was conducted during Rabi 2017-18 in RARS Lam Guntur in a randomized block design with 12 genotypes and replicated thrice grown under receding soil moisture condition.

Treatments consists of twelve genotypes of chickpea (JG11, KAK2, N119, N49, N47, N3, NBeg 399, NBeg 119, NBeg 49, Nbeg 47, Nbeg3, Vihar) obtained from RARS Nandyal. Sampling was done at 30, 50 days after sowing and maturity and drymatter accumulated in root, stem, leaf and pod, total drymatter was measured. The SCMR value was measured by using Minolta SPAD-502 Chlorophyll meter. Chlorophyll content was estimated by the method of (Hiscox and Israelstam, 1979) [2]. The relative water content was determined by according to the modified method of Bars and Weatherly (1962) [1]. The seed yield and yield components was recorded at maturity. The experiment data was statistically analyzed. (Panse and Sukhatme, 1985) [4].

Results and Discussions

The physiological process results into a net balance and accumulation of drymatter and hence, the biological productivity of plant is judged from their actual ability to produce and accumulate drymatter. There was a significant difference between chickpea genotypes for root, stem, leaf, pod and total drymatter at all stages of plant growth (Table 1). There was a gradual increase in root, stem, pod and total drymatter in all chickpea genotypes from 30 DAS to maturity. Among the genotypes tested, NBeg 47 recorded higher accumulation and partitioning of drymatter into root(1.42 g/ plant),stem (12.61 g/plant),leaf, (37.88 g/plant) pod (18.90 g/plant),total drymatter (37.88 g/plant) followed by NBeg 49, N-3 and NBeg399 whereas lower values was recorded in N119 (0.368,7.24,23.26,12.27 and 23.25 g/plant root,stem,leaf,pod and total drymatter respectively).At maturity the genotype NBeg 47 (37.88 g/plant) and NBeg 49 (32.81) recorded more total drymatter whereas genotype N119 (23.26 g/plant) recorded lowest total drymatter. Genotypic variation in drymatter production and partitioning of drymatter was observed in chickpea (Ulemale *et al.* 2013) [13]. Similar results were also reported by Reza Talebi *et al.* (2013) [9].

Photosynthetic pigments play an important role in light harvesting and dissipation of excess energy. There was a significant difference between the chickpea genotypes for chlorophyll a,b, total chlorophyll and SCMR.at 30 and 50 days after sowing (Table 2). There was a gradual decrease of chlorophyll a,b, total chlorophyll from 30 to 50 DAS. Among the genotypes tested, NBeg 47 recorded higher values of chlorophyll a (1.416 mg/g fresh weight of leaf) chlorophyll b (0.781 mg/g fresh weight of leaf),total chlorophyll (2.417 mg/g fresh weight of leaf) and SCMR(68.63) followed by NBeg 49 (1.382,0.766,2.153 mg/g fresh weight of leaf and 68.43), NBeg 399 (1.366,0.890,1.985 mg/g fresh weight of leaf and 64.66) whereas lower values of chlorophyll a (1.282 mg/g fresh weight of leaf) chlorophyll b (0.401 mg/g fresh weight of leaf), total chlorophyll (1.642 mg/g fresh weight of leaf) and SCMR(55.36) was recorded in N119. Higher chlorophyll content was observed in tolerant wheat and maize genotypes than susceptible one has also been reported (Kraus *et al.* 1995) [3]. Similar results were also reported in Gerbera by Qi-Xian *et al.* (2007) [6].

Relative water content (RWC) is one of the important parameter to measure water status of the tissue. There was a significant difference between the chickpea genotypes for RWC at 30 and 50 DAS. (Table 2).There was a gradual increase of RWC values in all chickpea genotypes from 30 to 50 DAS. Among the genotypes tested, NBeg 47 recorded higher values of RWC (85.13%) followed by NBeg 49 (83.42%), NBeg 399 (83.21%) whereas lower values of RWC was recorded in N119 (74.43%). Higher RWC under moisture stress denotes ability of plants to tolerate moisture stress (Ritchi *et al.* 1990) [10]. Under moisture stress conditions tolerant genotypes showed less reduction in RWC as compared to susceptible one (Sairam *et al.* 1997) [12]. Similar results were reported by Sairam and Srivastava (2001) [11] in wheat.

The generative growth and sink capacity related with final produce of the plant. It can reduce by soil moisture deficit conditions. There was a significant difference between chickpea genotypes for number of pods per plant, seed weight, and seed yield (Table 3).Among the genotypes tested, NBeg 47 recorded higher number of pods per plant (75.73) followed by NBeg 49 (72.53),N-3 (68.06) whereas lower values was recorded in N119 (46.33). Maximum seed weight was recorded in N119 (44.14 g) followed by NBeg 119 (42.70), NBeg 399 (39.91g) whereas lowest values was recorded in JG11 (23.20 g),.Maximum seed yield was recorded in NBeg 47 (3250 kg/ha) followed by NBeg 49 (3229 kg/ha), NBeg399 (2776 kg/ha) whereas lowest values was recorded inN-119 (2013 kg/ha).The higher seed yield in NBeg 47 and NBeg49 might be due to higher RWC, SCMR, higher chlorophyll content, higher total drymatter and more number of pods per plant. Similar results were reported by Rahangadale *et al.* (1992) [7] in chickpea. From these results it can be inferred that NBeg 47 and NBeg 49 chickpea genotypes are suitable for growing under receding soil conditions of Prakasam district of Andhra Pradesh.

Table 1: Drymatter partioning in chickpea genotypes at various growth stages

S. No	Genotypes	Root Drymatter (g/plant)			Stem drymatter (g/plant)			Leaf drymatter (g/plant)			Pod drymatter (g/Plant)	Total drymatter (g/Plant)		
		30 DAS	50 DAS	Maturity	30DAS	50DAS	Maturity	30 DAS	50 DAS	Maturity	Maturity	30DAS	50 DAS	Maturity
1	JG11	0.197	0.421	0.85	1.889	4.490	8.37	1.979	5.066	29.15	14.68	4.064	9.973	29.15
2	KAK2	0.190	0.377	0.80	1.796	4.162	7.62	2.467	4.619	24.25	13.07	4.451	9.158	24.25
3	N-119	0.189	0.368	0.78	1.934	3.856	7.24	2.302	5.233	23.26	12.27	4.424	8.457	23.26
4	N-49	0.242	0.719	1.18	2.289	7.333	9.65	2.911	6.388	31.32	16.13	5.441	14.439	31.32
5	N-47	0.247	0.732	0.90	1.716	6.247	8.63	2.375	7.048	28.26	15.41	4.337	14.026	28.26
6	N-3	0.237	0.679	1.10	2.201	7.754	9.43	3.117	6.139	32.57	17.60	5.552	14.570	32.57
7	NBeg 399	0.287	0.727	1.24	2.224	8.299	9.86	3.172	7.512	32.35	16.73	5.687	16.400	32.35
8	NBeg 119	0.220	0.640	0.94	1.678	6.364	6.10	2.053	6.200	25.23	14.69	4.945	13.210	25.23
9	NBeg 49	0.291	0.854	1.35	2.618	8.668	10.40	3.287	7.870	32.31	17.31	6.196	17.391	32.81
10	NBeg 47	0.307	0.857	1.42	2.678	8.956	12.61	3.411	8.490	37.88	18.90	6.580	18.308	37.88
11	NBeg 3	0.121	0.625	1.07	2.117	5.481	8.89	1.855	6.068	29.78	15.85	4.097	12.074	29.78
12	Vihar	0.209	0.433	1.02	2.001	4.828	8.54	1.917	5.209	28.89	15.40	4.128	10.655	28.89
CD 5%		0.02	0.075	0.11	0.30	0.35	3.28	0.19	0.61	5.2	2.5.0	0.45	0.75	5.2

Table 2: Chlorophyll content, SCMR and RWC values of chickpea genotypes at various growth stage.

S. No	Genotypes	Chlorophyll a (mg/g fresh wt)		Chlorophyll b (mg/g fresh wt)		Total Chlorophyll (mg/g fresh wt)		SCMR		RWC (%)	
		30 DAS	50DAS	30DAS	50DAS	30DAS	50DAS	30DAS	50DAS	30DAS	50DAS
1	JG11	1.296	1.333	0.510	0.281	1.644	1.633	64.06	58.30	65.13	77.17
2	KAK2	1.320	1.234	0.448	0.297	1.765	1.332	56.46	53.93	64.32	75.27
3	N-119	1.282	1.212	0.401	0.271	1.642	1.203	55.36	50.96	63.39	74.43
4	N-49	1.346	1.352	0.656	0.320	1.949	1.671	59.96	56.33	65.83	81.57
5	N-47	1.314	1.374	0.555	0.271	1.790	1.698	55.86	54.60	65.71	76.51
6	N-3	1.320	1.349	0.622	0.316	1.951	1.584	57.00	47.93	66.80	80.30
7	NBeg 399	1.366	1.411	0.680	0.341	1.985	1.765	64.66	52.53	70.38	83.13
8	NBeg 119	1.322	1.312	0.583	0.258	1.854	1.467	63.76	56.70	68.57	79.11
9	NBeg 49	1.382	1.378	0.766	0.401	2.153	1.775	68.43	53.23	72.76	83.42
10	NBeg 47	1.416	1.391	0.781	0.480	2.147	1.851	68.63	57.63	73.56	85.13
11	NBeg 3	1.321	1.341	0.607	0.231	1.866	1.651	52.60	52.70	68.48	79.52
12	Vihar	1.316	1.337	0.594	0.281	1.860	1.574	57.96	52.80	67.10	78.11
CD 5%		0.07	0.10	0.15	0.12	0.15	0.17	4.50	4.00	2.50	3.10

Table 3: Yield and yield components of chickpea genotypes

S. No	Genotypes	No of pods /plant	No of seeds per pod	100 Seed Weight (g)	Seed Yield (Kg /ha)
1	JG11	50.06	1.0	23.85	2504
2	KAK2	38.17	1.0	37.00	2479
3	N-119	46.33	1.0	44.14	2013
4	N-49	67.56	1.0	32.05	2757
5	N-47	63.10	2.00	29.46	2534
6	N-3	68.06	1.0	30.45	2714
7	NBeg 399	43.33	1.0	39.91	2776
8	NBeg 119	34.76	1.0	42.70	2673
9	NBeg 49	72.53	1.0	30.69	3229
10	NBeg 47	75.73	1.0	31.81	3250
11	NBeg 3	55.10	1.0	30.37	2757
12	Vihar	57.44	1.0	30.07	2756
CD 5%		14.84	NS	2.2	648

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