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Physiological evaluation of pigeonpea genotypes for drought tolerance

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Abstract
Field experiment was conducted during *kharif* 2017-2018 at RARS Lam Guntur to study the physiological evaluation of Pigeonpea genotypes for drought tolerance under rainfed conditions. The experiment was laid out in Randomized Block Design with seven pigeonpea genotypes and replicated thrice. The results revealed that significant differences were observed among the pigeonpea genotypes for plant height, Number of branches, Leaf area, dry matter production and partitioning leaf, stem, pod, total dry matter, SCMR, RWC, Chlorophyll a, b total chlorophyll, seed yield and yield components. Among the genotypes tested, LRG 160 recorded higher number of branches, Leaf area, dry matter production and partitioning in leaf, stem, seed and total dry matter, SCMR, RWC, chl. a, chl. b, Total chlorophyll, seed yield and yield components followed by LRG 52 where as lower values were recorded in LRG 151. Maximum seed yield was recorded in LRG 160 (1720kg/ha) followed by LRG 52 (1585 kg/ha) where as minimum seed yield was recorded in LRG 151 (1390 Kg/ha).

Keywords: pigeonpea, chlorophyll, Dry matter partitioning, RWC, seed yield, SPAD chlorophyll meter reading (SCMR)

Introduction

Drought is deleterious for plant growth, yield and mineral nutrition. (Garg *et al.*, 2004; Samarah *et al.*, 2004) [2, 13] and is one of the largest limiting factors in agriculture. (Reddy *et al.*, 2004) [14]. Seed yield is most affected by drought occurring in the flowering and early pod development stages. Genotypic differences in drought resistance are associated with maintenance of dry matter partitioning into leaves during and dry matter production following drought periods.

Pigeonpea is the second important pulse crop of India and recognized of a valuable source of proteins for the vegetarians in their daily diet. In India Pigeonpea is sown in an area of 4.09 million hectares with a production of 3.27 million tonnes. It is known that Pigeonpea thrives well under drought prone condition. However, there is a great variability for yield performance of different Pigeonpea genotypes under drought conditions. Attempts were made to select genotypes tolerant/ resistant to moisture stress condition based on morpho-physiological traits. The present investigation was made for physiological evaluation of Redgram genotypes for drought tolerance.

Materials and Methods

Field experiment was conducted during *kharif* 2017-2018 in RARS Lam, Guntur in Randomized Block Design with 7 genotypes and replicated thrice grown under rainfed conditions. Treatment consists of seven Pigeonpea genotypes (LRG 158, LRG 105, LRG 52, LRG 104, LRG 160, LRG 133-33, LRG 151) obtained from RARS Lam Guntur. Sampling was done at 30, 60, 90, 120 DAS and maturity and dry matter accumulation was measured. The SCMR was recorded by using the Minolta SPAD-502 chlorophyll meter. Chlorophyll was estimated by the method (Hiscos and Israelsten, 1979) [4]. The relative water content was determined by according to modified method of Bars and Weatherly (1962) [15]. The seed yield and yield components was recorded at maturity. The experimental data was statistically analysed.

Results and Discussion

Drought is the major constraint to crop growth production and crops are usually exposed to drought periods for varying duration and intensities. (Sadras and Milroy 1996). Plant height, number of branches and leaf area were important parameters in crops like Pigeonpea with indeterminate growth habit. There was a significant difference between the genotypes for plant height, number of branches and leaf area at maturity (Table 1). Among the genotypes tested, maximum plant height was recorded in LRG 104(222.3cm) followed by LRG 105 (216 cm) where as lowest plant height was recorded in LRG52 (193 cm). Among the genotypes tested, higher number of branches and Leaf area was recorded in LRG 160 (24.5 and 3816 cm^2/plant) followed by LRG 52 (23.10 and 3070 cm^2) whereas lower values were recorded in (14.50 and 2306 cm^2/plant). Similar results were also reported by Nagajyothi *et al.* (2004). The plants with higher leaf area were placed in a better position enabling them to harvest maximum solar radiation.

The dry matter accumulation in different plant parts was studied as each part of plant has a specific function and utility. The assimilate partitioning in component in component parts of plant can confirms the character related to drought tolerance. There was a significant difference between the redgram genotypes for leaf, stem, seed and total dry matter at maturity (Table 1). Among the genotypes tested, LRG 160 recorded highest leaf, stem, seed and total dry matter (30.86, 280.00, 151.33 and 462 g/plant) followed by LRG 52(27.93,266.53.140.0 and 434.0 g/plant) where as lowest values was recorded in LRG 151 (18.66, 190.6, 99.0 and 308 g/plant). LRG 160 is a very good genotype recorded highest dry matter accumulation in leaves as well as stem, seed and total dry matter production. Genotypic variation in dry matter and partitioning of dry matter was observed in redgram. Similar results were also reported by Nagajyothi *et al.* (2014).

Photosynthetic pigments play an important role in light harvesting and description of excess energy. There was a significant difference between the Pigeonpea genotypes for SCMR and chlorophyll a, b total chlorophyll at 30, 60, 90, DAS (Table 2, and Table 3). There was a gradual increase of SCMR from 30 DAS to 120 DAS. Among the genotypes tested, LRG 160 recorded highest values of chl. a, chl. b, total chlorophyll (1.333, 1.392 and 2.725 mg/g fresh wt) followed by LRG 105 (1.327, 1.326, 2.633 mg/g fresh wt) where as lowest values was recorded in LRG 151 (1.266, 1.128 and 2.362 mg/g fresh wt). Higher chlorophyll content was observed in tolerant wheat and maize genotypes than susceptible one also has been reported (Kraus *et al.*, 1995) [5]. Similar results were also reported in green gram genotypes by Qi-xian *et al.* (2007). Among the genotypes tested, LRG 160 recorded highest value of SCMR (62.16) followed by LRG 52 (60.43) whereas lowest values were recorded in LRG 151 (54.43) at 120 DAS.

Relative water content (RWC) is one of the measures to identify tissue water status. The plant water status increased progressively at vegetative stage and declined gradually as as the crop growth advanced. (Table 2). There was a significant difference between the genotypes for RWC at different growth stages in pigeonpea. Among the genotypes tested, LRG 160 recorded highest RWC values (88.47%) followed by LRG 52 (86.50%) where as lowest value of RWC was observed in LRG 151 (76.64%). High RWC may result from osmoregulation by osmoprotectants as carotenoids or sugars are often accumulated in plants subjected to drought stress (Gunes *et al.,* 2008) [3]. Similar results were observed in pigeonpea and chickpea (Nayyar and chander, 2004) [8].

Seed yield is the product of many growth processes occurring through the development of the plant. 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 pigeonpea genotypes for number of pods per plant, seed weight and seed yield (Table 3). Among the genotypes tested, the number of pods per plant was more in LRG 160 (391) followed by LRG 52 (365) where as lowest values were recorded in LRG 151 (274). Maximum seed weight was recorded in LRG 106 (13.21g) followed by LRG 105 (12.32g) where as the lowest values was observed in LRG 133.33 (11.67g). Maximum seed yield was recorded in LRG 160 (1720 kg/ha) followed by LRG 52 (1585 kg/ha) where as lowest values was recorded in LRG 151 (1390 kg/ha). The higher seed yield in LRG 160 and LRG 52 might be due to higher RWC, SCMR, higher chlorophyll content, higher total dry matter and more number of pods per plant. Similar results were reported by Naga Jyothi *et al.* (2014) [7] in redgram. From these results it can be inferred that LRG 160 and LRG 52 pigeonpea genotypes are suitable for growing under receding soil moisture conditions of A.P.

Table 1: Physiological characters and dry matter partioning of redgram genotypes at maturity

S. No	Genotypes	Plant Ht (Cm)	No of Branches /plant	Leaf area (Cm^2/Plant)	Lead dry matter (g/plant)	Stem dry matter (g/Plant)	Seed dry matter (g/Plant	Total dry matter (g/plant)
1	LRG158	202.3	15.63	2410	19.97	220.16	107.33	347
2	LRG105	216.0	22.37	2920	25.58	250.00	125.33	400
3	LRG52	193.0	23.10	3070	27..93	266.53	140.00	434
4	LRG104	222.3	21.35	2843	23.81	241.22	130.66	395
5	LRG160	202.6	24.50	3816	30.86	280.00	151.33	462
6	LRG133-33	210.3	22.70	2936	26.15	235.00	104.00	365
7	LRG151	204.6	14.50	2306	18.66	190.66	99.00	308
	CD 5%	15.34	2.75	609	5.63	13.34	11.45	15.34
	CV%	5.6	7.2	11.9	22.6	17.1	22.1	10.45

Table 2: SPAD Chlorophyll meter reading (SCMR) and Relative water content values of Redgram genotypes

S. No	Genotypes	SCMR					RWC (%)		
		30 DAS	60 DAS	90 DAS	120 DAS	Maturity	60DAS	90 DAS	120 DAS
1	LRG158	42.36	44.90	50.16	55.93	53.66	78.26	77.26	83.86
2	LRG105	44.06	45.73	50.56	56.93	54.96	76.79	80.32	83.66
3	LRG52	43.16	45.48	51.56	60.43	58.30	89.80	89.67	86.50
4	LRG104	45.06	44.56	50.53	58.93	56.86	84.87	84.92	79.45
5	LRG160	43.76	46.23	53.20	62.16	60.16	89.48	90.79	88.47
6	LRG133-33	44.76	43.06	51.78	58.66	56.43	88.71	86.44	83.79
7	LRG151	39.33	41.30	51.33	54.43	53.12	74.88	73.71	76.64

	CD 5%	2.40	1.20	1.10	2.15	2.12	5.7	5.93	5.35
	CV%	3.1	3.9	2.8	5.1	5.8	3.9	4.0	3.7

Table 3: Chlorophyll content and Yield and yield components of redgram genotypes

S. No	Genotypes	Chlorophyll a (mg/g fresh wt)	Chlorophyll b (mg/g fresh wt)	Total Chlorophyll (mg/g fresh wt)	No of pods /plant	No of seeds per pod	100 Seed weight (g)	Seed yield (Kg /ha)
1	LRG158	1.289	1.142	2.430	281	3.96	11.53	1410
2	LRG105	1.327	1.326	2.653	374	3.87	12.32	1435
3	LRG52	1.293	1.144	2.437	365	4.16	12.07	1585
4	LRG104	1.266	1.131	2.397	308	4.03	12.20	1470
5	LRG160	1.333	1.392	2.725	391	4.00	13.21	1720
6	LRG133-33	1.278	1.240	2.518	331	3.90	11.47	1502
7	LRG151	1.266	1.128	2.362	274	3.80	11.67	1390
	CD 5%	0.04	0.10	0.185	7.6	NS	0.28	84
	CV%	2.7	9.6	4.2	15.5	7.3	4.5	5.2

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