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RESPONSE OF COWPEA (*VIGNA UNGUICULATA* (L.) WALP) GENOTYPES TO DIFFERENT MOISTURE STRESS REGIMES

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ABSTRACT

The present investigation entitled "Response of Cowpea (*Vigna unguiculata* (L.) Walp.) genotypes to different moisture stress regimes" was carried out at PGI Farm, Department of Agril. Botanty, M.P.K.V., Rahuri, Dist. Ahmednagar (M.S.). The field experiment was carried out in Split plot design with three replications provided with four main treatments comprising of I_1: irrigation given at the time of germination, I_2: irrigations at the time of flower initiation (25DAS), I_3: irrigation at the time of 50% flowering (40DAS) and I_4: irrigation at the time of pod development (55DAS) and five sub-treatments comprising of five (varieties) namely: PhuleVithai, PhuleRakhumai, PhulePandhari, PCP-1123 and PCP-1124. Significant differences exhibited amongst the varieties for phenological, physiological parameters and yield attributes under moisture stress conditions.Among these varieties PCP-1123 recorded minimum days to 50% flowering,highest totalchlorophyll content, dry matter production, Drought Tolerance Efficiency, yield per hectare, harvest index followed by varieties PCP-1124, PhuleVithai, PhulePandhari under first irrigation i.e., Non-Stress condition which was optimum for high yieldandvarietyPhuleRakhumai showed lowest yield attributes. Therefore these varieties can be used for the improvement programme as well as efficient management practices for cowpea production in drought prone areas.

Key words : *Cowpea, phenological, moisture stress, drought tolerance efficiency.*

Cowpea (*Vigna unguiculata* L. Walp) is one of the important food grain crop belonging tofabaceae family. Cowpea commonly known as "Lobia" has a number of common names, including crowder pea, black eyed pea, china pea, cowgram, southern pea, kaffirpea and internationally as lubia, niebe, coupe or frijole.It is an annual herbaceous leguminious plant.Cowpea is primarily grown in drier regions of world where it is one of the most drought resistant food legume (1). Despite its inherent capacity to survive levels of drought that would render comparable crops unproductive (2) significant differences exist among cowpea genotype in drought tolerance. (3).

Moisture stress is one of the most prevelant environmental stress factor limiting plant growth, survival and productivity (4). Water stress causes deleterious physiological effects like membrane damage (5), reduction in root growth (6) and yield (7). The improvement in the genotypes is the only alternative for yield stability under moisture stress environment. Therefore the study was undertaken with the objective to access the effect of moisture stress regimes on cowpea genotypes and to identify stress tolerant cowpea genotypes.

MATERIALS AND METHODS

The experimental material comprised of five varieties of cowpea, Phule Vithai, Phule Rakhumai, Phule Pandhari, PCP-1123 and PCP-1124 under moisture stress conditions in split plot design with three replications at PGI farm, Mahatma Phule Krishi Vidyapeeth Rahuri, Dist. Ahmednagar (MS) India during the Summer 2019-20.The fertilizer dose was applied before sowing @ 25 kg N, 50 kg P_2O_5 and 50 K_2O per hectare. The sowing was done by dibbling method with the spacing 45×10 cm and plot size 4.0×1.8 m^2.Gap filling was carried out by 15 days after sowing. At the same time thinning was done by keeping only one healthy plant per hill.Five random competitive plants were selected from each plot and following observation were recorded viz., Total chlorophyll content, dry matter production, yield per hectare, Harvest index and Drought Tolerance Efficiency. The index of total chlorophyll (SPAD index) of randomly selected leaves was recorded by using the instrument SPAD meter at 50% flowering. Harvest Index was worked out by formula given by (8).

$$\text{HI (\%)} = \frac{\text{Economic yield}}{\text{Biological yield}} \times 100$$

The percent reduction due to moisture stress was calculated by using formula

$$\text{Reduction (\%)} = \frac{\text{Yield under non - stress} \quad \text{Yield understress}}{\text{Yield under non - stress}} \times 100$$

Drought Tolerance Efficiency was calculated as per the formula.

$$\text{DTE} = \frac{\text{Grain yield under water stress condition}}{\text{Grain yield under irrigated condition}} \times 100$$

RESULTS AND DISCUSSION

Phenological Characters : Minimum days for 50% flowering are important trait to escape drought stress due

Table-1 : No. of Days to 50% flowering.

Treatments / Varieties	I_1	I_2	I_3	I_4	Mean	% reduction I_2	% reduction I_3	% reduction I_4
Phule Vithai	53.50	52.00	45.33	42.00	48.21	4.67	15.83	26.00
Phule Rakhumai	54.07	52.07	45.01	41.00	48.04	4.00	16.93	25.00
Phule Pandhari	57.00	52.00	50.00	46.00	51.25	9.00	14.00	20.00
PCP-1123	51.00	43.00	42.80	40.00	44.20	15.00	12.44	21.56
PCP-1124	51.04	43.40	43.00	42.33	44.94	15.00	16.00	17.96
Mean	53.32	48.49	45.23	42.27	47.33			
Source			SE (m) +			CD at 5%		
Main plot			0.373			1.290		
Sub plot			0.370			1.067		
Main x Sub			0.741			2.134		

Table-2 : Chlorophyll content.

Treatments / Varieties	I_1	I_2	I_3	I_4	Mean	% reduction I_2	% reduction I_3	% reduction I_4
Phule Vithai	70.90	67.08	64.01	60.95	65.74	5.38	9.71	14.01
Phule Rakhumai	67.98	65.09	60.05	57.00	62.53	4.25	11.66	16.11
Phule Pandhari	70.80	66.00	63.33	62.39	65.63	6.77	10.56	11.87
PCP-1123	71.85	69.67	65.35	60.94	66.95	3.15	9.00	16.00
PCP-1124	71.00	66.29	64.00	62.10	65.85	6.63	9.85	12.52
Mean	70.51	66.83	63.35	60.68	65.34			
Source			SE (m) +			CD at 5%		
Main plot			0.272			0.943		
Sub plot			0.332			0.956		
Main x Sub			0.664			1.913		

Table-3 : Dry matter production (g).

Treatments / Varieties	I_1	I_2	I_3	I_4	Mean	% reduction I_2	% reduction I_3	% reduction I_4
Phule Vithai	21.30	17.98	15.97	13.08	17.08	15.09	25.02	38.59
Phule Rakhumai	19.04	17.00	13.20	11.44	15.17	10.71	30.34	39.91
Phule Pandhari	20.21	16.97	14.92	12.59	16.17	16.02	26.07	37.70
PCP-1123	22.02	19.50	15.75	13.57	17.71	11.44	28.27	38.27
PCP-1124	21.03	17.80	15.11	13.50	16.86	15.35	28.00	35.62
Mean	20.72	17.85	14.99	12.84	16.60			
Source			SE (m) +			CD at 5%		
Main plot			0.126			0.437		
Sub plot			0.127			0.366		
Main x Sub			0.254			0.732		

to the onset of severe water deficit in cowpea. In present investigation, (Table-1) the variety PCP-1123 required minimum number of days for 50% flowering (40) under severe moisture stress conditions. Under irrigation treatment I_1 i. e., non stress condition, PCP-1123 had also recorded minimum number of days to 50% flowering (51). PCP-1124 is also another variety which required minimum number of days for 50% flowering (42.33) under severe moisture stress conditions while maximum days for 50% flowering (46) was required by variety Phule Pandhari under severs moisture stress condition.The minimum percent reduction in 50% flowering was observed in the variety PhuleRakhumai about 4% under I_2 irrigation treatment, in PCP-1123 about 12.44% under irrigation treatment I_3 and in PCP-1124 under I_4 about 17.96%.

Physiological parameters : Reduction in chlorophyll content was observed due to moisture stress condition

Table-4 : Drought Tolerance Efficiency (%).

Treatments / Varieties	I_1	I_2	I_3	I_4	Mean
Phule Vithai	56.30	70.78	91.48	92.04	77.65
Phule Rakhumai	64.90	81.17	92.73	92.75	82.89
Phule Pandhari	62.91	78.71	83.91	85.00	77.63
PCP-1123	66.97	83.69	95.64	96.03	85.58
PCP-1124	65.89	82.35	94.15	95.00	84.35
Mean	63.39	79.34	91.58	92.16	81.62
Source		SE (m) +		CD at 5%	
Main plot		0.014		0.049	
Sub plot		0.103		0.299	
Main x Sub		0.207		0.598	

Table-5 : Yield per ha (q).

Treatments / Varieties	I_1	I_2	I_3	I_4	Mean	% reduction I_2	% reduction I_3	% reduction I_4
Phule Vithai	11.76	10.11	8.32	7.01	9.30	16.00	30.66	41.58
Phule Rakhumai	9.70	8.02	7.02	5.99	7.68	20.03	30.00	40.27
Phule Pandhari	11.08	8.80	8.05	6.60	8.63	20.79	27.54	40.59
PCP-1123	13.02	11.49	9.07	7.45	10.26	12.62	31.02	43.34
PCP-1124	12.88	10.20	9.00	8.45	10.13	21.47	30.71	34.94
Mean	11.69	9.72	8.29	7.10	9.30			
Source			SE (m) +			CD at 5%		
Main plot			0.036			0.126		
Sub plot			0.069			0.201		
Main x Sub			0.139			0.402		

Table-6 : Harvest Index (%).

Treatments / Varieties	I_1	I_2	I_3	I_4	Mean
Phule Vithai	27.69	25.21	22.48	22.00	24.34
Phule Rakhumai	23.31	20.56	18.95	17.81	20.16
Phule Pandhari	26.37	22.00	21.00	20.14	22.38
PCP-1123	27.78	22.98	21.54	20.77	23.27
PCP-1124	25.76	21.70	21.42	20.52	22.35
Mean	26.18	22.49	21.08	20.25	22.50
Source		SE (m) +		CD at 5%	
Main plot		0.066		0.230	
Sub plot		0.116		0.334	
Main x Sub		0.232		0.668	

(Table-2). Total chlorophyll content recorded using the instrument SPAD meter at 50% flowering showed that the variety PCP-1123 (71.85) had maximum chlorophyll content under non-stress condition I_1 and the variety PhuleRakhumai (67.98) showed minimum chlorophyll content under non-stress condition. Under severe moisture stress condition I_4, PhulePandhari (62.39) had higher chlorophyll content and lower chlorophyll content was of PhuleRakhumai (57.00). The minimumpercent reduction was observed under I_1 and I_2 in PCP-1123 which was 3.15% and 9% respectively and 11.87% in PhulePandhari under I_3.

The physiological processes results into a net balance and accumulation of dry matter and hence biological productivity of plant is judged from their actual ability to produce and accumulate dry matter. In present experiment, (Table-3) dry matter production under non-stress condition I_1 was highest of (22.02) variety PCP-1123 and lowest (19.04) was in variety Phule

Rakhumai. Under severe moisture stress condition I_4, dry matter production was higher in PCP-1123 (13.57) and lower in PhuleRakhumai (11.44). The minimum percent reduction was observed under I_2 in Phule Rakhumai which was 10.71% and under I_3 in Phule Vithai (25.02%) and under I_4 in PCP-1124 (35.62%).

Drought Tolerance Efficiency (Table-4) was found to be higher in variety PCP-1123 (96.03) under severe moisture stress condition I_4 followed by PCP-1124 (95.00) and lowest in Variety Phule Vithai (56.30).

Yield and yield contributing characters : In the present investigation, (Table-5) under non-stress condition I_1, PCP-1123 (13.02) showed maximum yield and Phule Rakhumai (9.70) showed minimum yield per hectare. And variety PCP-1124 (8.45) showed higher yield per hectare followed by variety PCP-1123 (7.45) under severe moisture stress condition I_4 and lower in variety Phule Rakhumai (5.99). Minimum percent reduction was recorded under I_2 in variety PCP-1123 upto 12.62% and under I_3 in Phule Pandhari at about 27.54% and under I_4 in Phule PCP-1124 about 34.94%

Harvest Index helps in knowing how much of the total dry matter is converted into the economic part. Higher the conversion, higher will be harvest index. In the present investigation, (Table-6), Higher HI was observed in the variety PCP-1123 about (27.78) and the lower HI was shown by the variety PhuleRakhumai (23.31) in non-stress irrigation treatment I_1 and under severe moisture stress treatment I_4 variety PhuleVithai (22.48) showed maximum HI and Variety PhuleRakhumai (18.95) showed minimum HI.

CONCLUSIONS

In general, the varieties PCP-1123 found promising under non-stress as well as severe moisture stress conditions. These varieties have indicated less yield reduction due to moisture stress and such found to be stable the high yielding. Hence it was found that, Variety PCP-1123 exhibited higher values for drought tolerance and can be used in further breeding programme for evolving the drought tolerant genotypes in cowpea.

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