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IDENTIFICATION OF STABLE PHYSIOLOGICAL TRAITS FOR CERTAIN CULTIVARS OF PIGEONPEA IN DMA

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In any crop improvement programme, it is necessary to identify the stable variety for physiological traits which could perform more or less uniformly under different environmental conditions. In view of its great importance, the present study was carried out to find out the stability of dry matter accumulation (DMA) and its components in pigeonpea. The study revealed that none of the cultivar could be indentified for DMA. However, CORG 5 indentified for its stability in photosynthetic rate, CORG 11 for LAI, UPAS 120 for leaf-stem ratio and SA 1 for ILA. So it is evident from this study that these cultivars can be used for crop improvement research in pigeonpea.

Importance of studying the stability analysis for physiological traits for pigeonpea improvement has been stressed by Lawn (1980). Among the many physiological traits, DMA was considered to be the important traits for yield improvement in this crop (Ekshringe *et al.*, 1983). As it is a quantitatively short day plant, its DMA is highly variable under different environmental conditions (Willis *et al.*, 1980). The DMA is a complex phenomena and it is governed by so many physiological traits such a photosynthesis (Upretty et al., 1980) LAI (Tayo, 1983) and individual leaf area (Sharma and Saxena, 1983). So, an attempt has been made in this present study to find out the staple physiological traits for the stability of DMA in pigeonpea.

MATERIALS AND METHODS

Six pigeonpea cultivars comprising of three long duration (CORG 11, PLS 361/1 and SA 1) and three short duration cultivars (CO 5, CORG 5 and UPAS 120) were employed in this study. All these cultivars were grown under three different seasons with the following sowing dates, February 21 (I) June 21 (II) and September 21 (III). The experiment was conducted in Millet Breeding Station Tamil Nadu Agricultural University, Coimbatore in a randomised design replicated thrice. All the plots were received NPK 20: 40:0 as urea, superphosphate and muriate of potash at the time of seeding. Uniforn irrigation, plant protection and cultural operations were followed in all the three sowing dates. A fully expanded young trifoliate, from the top (Rawson and Constable, 1980) at 50% flowering was measured in all the three sowing dates The LAI was also measured at 50% flowering (Williams, 1946). The (ILA) individual leaf area (trifoliate leaf) stem weight, leaf/stem ratio (Leaf weight/stem weight)

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were measured at harvest stage. Following the methodology of Eberhart and Russell's model (1966) stability traits were estimated.

RESULTS AND DISCUSSION

The analysis of variance (Table 1) showed that the environmental differences were highly significant, indicating diverse type of seasons. The cultivar differences were also significant. The mean square (cultivar and season) was significant for all traits except for photosynthesis. The season mean square (linear) was found to be significant for all traits except in leaf/stem ratio. The cultivar X season mean square (linear) was found to be significant for all traits except ILA and photosynthesis. None of the trait was found to be significant in non linear components (pooled deviation). Similar results have been already reported in pigeonpea by Ramanujam (1975).

The stability analysis for individual traits have been carried out for all the three seasons. Three parameters of stability, namely, mean value, regrsesion coefficient (bi) and deviation mean square (S¯d') were considered desirable criteria for identifying the stable cultivar for physiological traits (Table 2-7).

The cultivars showed high mean (mean + two se), bi around unity and S–d' around zero were considered for high stability over seasons (Eberhart and Russel, 1966). As regards photosynthesis CORG 5 was considered to be stable over the seasons (Table 2). In the case of LAI (Table 3), CORG 11 was found to be stable over three seasons. SA 1 the long duration cultiver was found to be in ILA (Table 4) whereas UPAS 120 was stable for leaf stem ratio (Table 6). None of the cultivar could show stability for stem weight and DMA (Table 6 and 7).

The unstability of DMA over season could be ascribed to the unstability of LAI and photosynthesis over seasons.

Eventhough photosynthesis was identified as stable traits In CO 5, it failed to stabilise LAI and vice-versa in CORG 11. The combination of LAI and photosynthesis decide the quantum photosynthesis that can be produced for DMA. This was also evident that stem dry weight as a major contributor for DMA in pigeonpea (Narayanan and Sheldrake, 1976) showed instability over the seasons. This may be the probable reason for the unstability of DMA over seasons. In this context, Jagshoran (1985) found that the relationship between linear and non-linear responses were observed to be character specific in pigeonpea.

It could be concluded from this study that DMA is an unstable traits in pigeonpea. This unstability could be as cribed to the LAI, photosynthesis and stem dry weights, analysing the individual traits for cultivars CO 5 in photosynthesis, LAI in CORG 11, L/S

Table 1. Analysis of variance for phenotypic stability Mean (squares)

Source	df	LAI	Individual leaf area	Photo-synthesis	Stem weight	Leaf/ stem ratio	DMA
Cultivar	5	243.66**	36.49**	24.09**	1123423.69**	0.409**	22.70059.14*
Season	2	899 94**	181.27**	73.52**	4313393.98**	0.395**	8368775.51**
Cultivar X Season	10	129.69**	8.65**	3.38	805752.16**	0.028**	1493737.17*
Season (Linear)	1	599 96**	120.85**	49.01**	2875595.98**	0.256	5579183.97**
C x S Linear)	5	86.31**	3.52	1.62	527002.10**	5.18*	995252.97**
Pooled deviation (Non-linear)	6	0.124	1.88	0.53	138.34	0.015	476.49
Pooled error	30	0.576	1.83	3.52	658.96	1 55	6210.55

Table 2. Stability analysis for photosynthetic rate at 50% flowering (mg CO_2, dm-2, hr-1)

Variety	Seasons				Regre-ssion coeffi-cient (b)	Mean square devia-tion (S-d²)
	I	II	III	Mean		
CO 5	26.3	22.8	21.6	23.6	1.12	0.49
CORG 5	28.6	25.4	22.3	25.4	1.54	−0.92
UPAS 120	23.0	22 8	19.8	21.9	0.83	−0 43
CORG 11	25 9	23.7	20.1	23.2	1.45*	−1.19
PLS 361/1	21.8	21.6	19.7	21.0	0.54	−0.93
SA 1	22.3	21.9	20.3	21.5	0 51	−1.09
Mean	24 65	23.03	20.63	22.76	1.00	
SE	1.28	1.37	0.351	0.634	0.254	

Table 3. Stability analysis for LAI at 50% flowering

Variety	Seasons I	II	III	Mean	Regression coefficient (b)	Mean square deviation (S·d²)
CO 5	3.52	1.16	0.56	1.75	0.22	−0.15
CORG 5	3.12	1.46	0.46	1 68	0.18	0.089
UPAS 120	1.45	0.53	0.32	0.76	0.084	−0.19
CORG 11	22.60	4.46	2.15	9.74	1.58	−0.19
PLS 361/1	27.50	4.34	2.08	11.31	1.99*	−0.067
SA 1	27.20	4 47	2.53	11.40	1.93*	0.089
Mean	14.23	2.74	1.35	6.11	1.00	
SE	0.755	0.085	0.038	0.254	0.035	

Table 4. Stability analysis for individual leaf area (cm², leaf⁻¹)

Variety	Seasons I	II	III	Mean	Regression coefficient (b)	Mean square deviation (S·d²)
CO 5	12.3	10.5	7.7	10.17	0.71	0 030
CORG 5	1.56	10.6	8.7	11.63	1.11	−0.168
UPAS 120	15.0	9.1	6.9	10.33	1.31	0.038
CORG 11	14.4	15.6	11.0	13.67	0.47	6.37
PLS 361/1	20.5	13 9	10.3	14.97	1.59*	−0.42
SA 1	17.1	12.3	12.3	13.90	0.80	1 74
Mean	15.81	12.0	9.52	12.45	1.00	
SE	0.881	0.762	0.685	0.451	0.305	

Table 5. Stability analysis for stem weight at harvest stage ($g.m^{-2}$)

Variety	Seasons I	II	III	Mean	Regression coefficient (b)	Mean square deviation ($S^{-}d^{2}$)
CO 5	38.07	11.0	5.2	18.09	0.036	−213.37
CORG 5	50.81	12.8	6.0	23 20	0.049*	−212.86
UPAS 120	20.95	4.9	2.9	9.58	0 020*	−219.39
CORG 11	1695.00	138.4	42.8	625.07	1.89**	61.28
PLS 361/1	1752.50	190.0	37.4	659.67	1.94**	219.66
SA 1	1859.80	173.8	56.9	696.83	2 06**	−123 19
Mean	902.85	88.48	25.03	338.79	1.00	
SE	25.76	4.30	1.24	8.56	0.017	

Table. 6 Stability analysis for leaf/stem ratio at harvest stage ($g.m^{-2}$)

Variety	seasons I	II	III	Mean	Regression coefficient (b)	Mean square deviation ($S^{-}d^{2}$)
CO 5	0.45	0.79	0.73	0 66	1.09	0.014**
CORG 5	0.33	0.75	0.57	0.53	1.03	0.043*
UPAS 120	0.46	0.65	0.79	0.64	1.37	1.49
CORG 11	0.11	0.17	0.40	0.23	0.91	0 012**
PLS 361/1	0.11	0.19	0.41	0.24	0 98	9.65
SA 1	0.11	0.18	0.38	0.22	0.85	7.94
Mean	0.262	0.456	0.546	0 42	1.00	
SE	0.029	0.020	0.17	0.013	0.591	

Table 7. Stability analysis for DMA (g/m-²)

Variety	Seasons I	II	III	Mean	Regression coefficient (d)	Mean square deviation (S-d)
CO 5	132.6	73.6	46 00	84.07	0.063	−1846.97
CORG 5	149.8	85.9	50.80	95.50	0.071	−1682.45
UPAS 120	88.4	57.2	36 10	60 56.	0.036	−1919.26
CORG 11	2400.4	284.0	142.61	942.47	1.85**	−765 66
PLS 361/1	2348.7	340.0	116.14	1001.61	1.97**	−1880.77
SA 1	2615.1	340.2	167.10	1048.80	2.00**	−1466.97
Mean	1322.3	196.8	93.1	538 84	1.00	
SE	76.69	16.99	6.28	26.29	0.023	

*Deviating from unity (bi) and zero (S-d²)

*1% level **5% level.

ratio in U P A S 120 and ILA in SA I were identified as stable physiological traits over seasons. So, these cultivars can be used for further crop improvement in pigeonpea.

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