ASSOCIATION OF SOME PHYSIOLOGICAL DETERMINANTS WITH SEED YIELD IN TORIA (BRASSICA CAMPESTRIS, (L) VAR. TORIA)

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Physiological attributes have been found to effect directly towards the expression of seed yield (Jennings, 1964 in rice ; Donald, 1968 in field crops and Mock and Pearce, 1975, in maize). Therefore, the present study was undertaken to know the type of association between seed yield and some physiological attributes and to judge the direct and indirect effect of these on seed yield through path coefficient analysis in toria (Brassica campestris (L), Var. toria).

MATERIAL AND METHODS

20 genotypes of toria were grown in a randomized block design consisting of three replications at the farm of Haryana Agricultural University, Hissar during Rabi 1979-80. Each genotype was grown in 10 rows plot of 6 m length with a spacing of 30 cm x 10 cm, between and within rows respectively. In order to have the estimation of different physiological parameters 10 competitive plants were uprooted at each of the following four stages viz., vegetative stage, flowering stage, full bloom stage, post bloom stage.

For measuring the total area, representative sample i.e., large, medium and small leaves were taken form each genotype in all the replications and the leaf area was recorded with the help of leaf area meter in cm^2. Finally, the total leaf area was calculated on the basis of dry leaf weight. The harvested material (i.e., leaves, shoot, inflorescence, siliquae) was kept in a hot air oven at a constant temperature of 80°C for a period of 48 hours and the total dry matter of plant was weighed. The interval between each stage constitutes a phase. In this study, the data were utilized for two phases namely ; pre-flowering phase i.e., obtained by substracting vegetative stage (15 days after plantation) from flowering stage (30 days after plantation) and post flowering phase i.e., obtained by substracting the full bloom stage (45 days

after plantation) from post bloom stage (60 days after plantation).

The physiological attributes namely : mean net assimilation rate (NAR) , mean leaf area index (LAI), mean leaf area duration (LAD) at phase 1st and 2nd and harvest index (HI) were calculated as per formulae suggested by Radford (1967). The data with respect to seed yield per plant were also recorded to calculate its correlation and path coefficient with different physiological attributes as per methods suggested by Al-jibouri et al. (1958) and Dewey and Lu (1959) respectively.

RESULTS AND DISCUSSION

The genotypes differed significantly with respect to seed yield and different physiological traits under study. The estimation of correlations both at phenotypic and genotypic level have been presented in table-1. In general, the genotypic correlations were of higher magnitude as compared to their corresponding phenotypic correlations. This indicated the presence of strong inherent association among various characters, the phenotypic expression of the correlation is lessened under the influence of environment. Leaf area ratio (LAR) which represents leaf area divided by shoot dry weight and hence a unit increase in leaf area. In the present study, LAR (2nd phase) exhibited a significant positive association with seed yield. The high leaf area and leaf area ratio go together and lead to the higher yield (Wallace and Munger, 1965). Few workers like Wallace and Munger (1965) in beans and Watson (1958) in Kale and sugarbeet also demonstrated that LAR was a chief determinant of seed yield. Further, leaf area duration (LAD) of a crop is the measure of its ability to produce leaf area on unit area of land throughout its life. This growth parameter has been widely utilized as a better measure of the size of assimilatory system of the crop. In this study, this growth parameter at post anthesis period of growth was observed to have significant positive association with seed yield. The greater significance of LAD after anthesis was observed in the present studies as a determinant of seed yield. In fact, it may be a consequence of the relatively longer duration of post anthesis phase of growth than the corresponding pre anthesis period (Thurling, 1974). The 'harvest index', an indicative of the efficiency with which the photosynthates are translocated from the organs of assimilation (leaves) to the organs of economic value (seed), showed significant positive association with seed yield. These findings were in agreement to that of Thurling (1974) in Brassica campestris. NAR (1st and 2nd phase) exhibited poor association with seed yield indicating thereby, no significance of this physiological parameter in breeding programme as far as the material in hand is concerned. Thurling (1974) also observed negative association of seed yield with NAR in Brassica campestris. Besides NAR, the other growth parameters like CGR (1st and 2nd phase), LAD (1st phase) and NAR (1st phase) also did not give encouraging associations with seed yield. This indicated the use of more assimilates in biological parts of no economic value.

The correlation coefficient analysis indicated that seed yield to be the resultant of high LAD, LAR during post anthesis period of growth and also high harvest index. Path coefficient

analysis also revealed the importance of these characters owing to high direct effects on seed yield (table-2). Besides these growth parameters NAR (1st and 2nd phase), LAD and LAR (1st phase) also exhibited the positive direct-effects, though their association with seed yield was observed to be very poor. The high direct effect of NAR (2nd phase) was nullified indirectly through all the characters with the exception of LAD and LAR (1st phase). Similarly, the high direct effect of LAD (1st phase) was mainly cancelled indirectly by CGR (1st phase) followed by LAD and LAR (2nd phase).

The present results indicated that growth attributes like HI, LAD and LAR after anthesis period of growth would prove useful as a selection criterion in breeding for high yielding strains of toria. HI, a yield contributing character has attained greater importance but very little is known about its genetic and physiological control. It is, however, recognised that harvest index does reflect the plant capacity to translocate photosynthates to the organs of economic importance. LAD and LAR which had significant positive association with seed yield would also be considered as an important selection criterion. But, certainly, it seems to be difficult for a breeder to measure these traits in large breeding populations. Therefore, these parameters appear to be less useful than HI as a selection criterion. Finally, it may be suggested that still more information is needed especially with respect to the genetics of physiological traits in order to assess their value as a selection criterion in the future breeding programme aiming at the improvement of yield in toria.

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Table-1: Genotypic (above diagonal) and phenotypic (below diagonal) correlation coefficients for seed yield and some physiological attributes.

Character	Seed yield	NAR		LAD		CGR		LAR		Harvest index
		1st	2nd	1st	2nd	1st	2nd	1st	2nd	
Seed yield	–	−0.06	−0.31	−0.36	0.45	−0.46	−0.08	−0.01	0.66	0.47
NAR (1st phase)	−0.06	–	−0.01	−0.04	0.35	0.22	0.18	−0.42	0.04	−0.10
NAR (2nd phase)	−0.30	0.01	–	0.16	−0.40	0.20	0.78	0.09	−0.54	−0.38
LAD (1st phase)	−0.36	0.04	0.16	–	−0.33	0.95	−0.01	0.27	−0.40	0.07
LAD (2nd phase)	0.44*	0.32	−0.39	−0.33	–	−0.35	0.21	0.16	0.75	0.03
CGR (1st phase)	−0.45*	0.21	0.20	0.95*	−0.33	–	0.01	0.09	−0.45	0.04
CGR (2nd phase)	−0.08	0.17	0.77*	−0.01	0.21	0.01	–	0.34	−0.13	−0.36
LAR (1st phase)	−0.01	−0.39	0.09	0.27	0.16	0.09	0.34	—	0.03	−0.21
LAR (2nd phase)	0.65*	0.03	0.54*	−0.39*	0.75	−0.45*	−0.13	0.03	–	0.33
Harvest index	0.45*	−0.10	−0.37	0.07	0.03	0.05	−0.36	−0.21	0.32	–

* *Denotes significance at P = 0.05*

Table-2 : Direct (diagonal) and indirect (Off diagonal) influence of different physiological characters at genotypic level on seed yield in toria.

Characters	NAR		LAD		CGR		LAR		Harvest index	Genotypic correlat-ions
	1st	2nd	1st	2nd	1st	2nd	1st	2nd		
NAR (1st phase)	0.34	−0.01	0.04	0.20	−0.33	−0.18	−0.08	0.01	−0.05	−0.06
NAR (2nd phase)	−0.01	1.20	0.17	−0.22	−0.30	−0.80	0.02	−0.18	−0.19	−0.31
LAD (1st phase)	0.01	0.19	1.09	−0.19	−1.43	0.01	0.05	−0.13	0.04	−0.36
LAD (2nd phase)	0.12	−0.48	−0.36	0.56	0.52	−0.22	0.03	0.26	0.01	0.45
CGR (1st phase)	0.08	0.25	1.03	−0.20	−1.50	−0.01	0.02	−0.15	0.02	−0.46
CGR (2nd phase)	0.06	0.94	−0.02	0.12	−0.01	−1.02	0.07	−0.04	−0.18	−0.08
LAR (1st phase)	−0.14	0.11	0.30	0.09	−0.13	−0.35	0.20	0.01	−0.10	−0.01
LAR (2nd phase)	0.01	−0.66	−0.43	0.42	0.67	0.13	0.01	0.34	0.16	0.66
Harvest index	−0.04	−0.46	0.08	0.02	−0.07	0.36	−0.04	0.11	0.50	0.47

Residual effect = 0.294