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RESEARCH ARTICLE

Relationship and Association Analysis in the Cultivated and Wild Species of Sesame

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ABSTRACT

The experimental study was undertaken in the Wild species garden and Oilseeds farm at Tamil Nadu Agricultural University, Coimbatore, during Rabi' 2021 to know the association between yield and its component traits in cultivated and wild species of Sesame. Nine varieties of *Sesamum indicum* and three wild species, namely *Sesamum alatum, Sesamum malabaricum,* and *Sesamum radiatum* were assessed for eight quantitative traits namely plant height, the number of branches per plant, days to first flowering, the number of capsules per plant, the number of seeds per capsule, capsule length, thousand seed weight and yield per plant. The correspondence among the cultivated and wild species of Sesame was explicated over the heatmap in which cultivated varieties of *Sesamum indicum* were categorized under three clusters and wild species into two clusters. Correlation analysis revealed that seed yield per plant emphasizes a positive and high significant correlation with a number of capsules per plant and thousand seed weight. Path analysis delineated that number of capsules per plant had a high positive direct effect on yield followed by a less positive direct effect on thousand seed weight and a number of branches, while thousand seed weight has high positive indirect effect on seed yield per plant via number of capsules per plant. It can be concluded that the traits, namely number of branches, number of capsules and thousand seed weight recorded both significant positive correlation and high direct effect on single plant yield. Therefore, the selection process prioritizing these traits with higher values would be rewarding in Sesame crop improvement breeding program.

Keywords: *Sesame; Correlation; Coefficient; Path Analysis; Number of Capsules*

INTRODUCTION

Sesame is one of the oldest oilseed crops known to human beings and its cultivation expedites to 3050–3500 BC (Bedigian and Harlan, 1986). Genetic arguments justify the Indian origin of the crop. India holds the second position in the area under sesame cultivation (16.2 lakh ha.) and the third position in production (0.657 million tonnes). Taxonomically, Sesame falls under the genus Sesamum which encompasses about 36 species (Joshi, 1961). The wild species of Sesame embodies potential candidate genes for various traits viz., biotic and abiotic stress tolerance, seed yield, male sterility, etc.

Sesame (*Sesame indicum* L.) is the cultivated species of Sesame that is raised throughout the year as it grows well in many of the cropping systems and is easily adaptable even under moisture stress conditions with very limited management strategies by small and marginal farmers. Amidst the presence of valuable features in sesame, the yield potential of sesame is not fully extracted. Hence utilization of genetic resources and appreciating the association of characters is a precondition in terms of Sesame breeding.

The eventual pronouncement of yield in crop plants is harnessed by the action and relationship among several characters. A Boon of interrelation among quantitative traits is prerequisite for assigning a productive breeding program. Correlation analysis assists in extracting the strength of estimating the critical components of a complex trait like yield. Inevitably, the path coefficient analysis promotes splitting up the contribution of component characters about yield into direct and indirect effects through

other characters to disclose the cause and effect relationship (Wright, 1921).

The present study aims to look into the varieties of cultivated species and wild species of Sesame to appraise the functional relationship between the yield and yield governing traits which could be utilized in Sesame breeding for improvement of traits and selection of suitable parents based upon such traits for crop breeding program.

MATERIAL AND METHODS

Plant genetic materials

The experimental materials for the present study included nine varieties of Sesamum indicum viz., CO1, VRI 1, VRI 2, VRI 3, TMV 3, TMV 4, TMV 7, SVPR 1, Paiyur1, and wild species, namely Sesamum alatum, Sesamum malabaricum and Sesamum radiatum. The genetically pure seeds of experimental materials were acquired from the Department of Oilseeds, Tamil Nadu Agricultural University, Coimbatore was the experiment was conducted in Wild species garden and Oilseeds farm at TNAU, Coimbatore (latitude and longitude of 9.9252° N, 78.1198° E) during Rabi season of 2021.

Evaluation of traits

The recommended nutrients and spacing's were dispensed during the crop growth period. Observations on a total of eight traits viz., plant height, number of branches per plant, days to first flowering, number of capsules per plant, number of seeds per capsule, capsule length, thousand seed weight, and yield per plant were taped on five plants on each genotype.

Statistical analysis

Correlation coefficients were calculated in line with the formula put forth by Goulden (1952). Path coefficients were determined by the methods stated by Dewey and Lu (1959). The estimates of correlation coefficient and path coefficient analysis were calculated by examining the data employing TNAUSTAT statistical package.

RESULTS AND DISCUSSION

The correspondence among the cultivated and wild species of Sesame was explicated over the heatmap (Fig. 1.). There were entirely five clusters formed among the genotypes. Cluster 1 consisted of *Sesamum indicum* variety CO 1 while cluster 2 housed two wild species, namely *Sesamum malabaricum* and *Sesamum radiatum*. Cluster 3 included VRI 2 and VRI 1. The number of genotypes in cluster 4 was higher, comprising six Sesamum indicum varities viz., TMV 7, Paiyur 1, TMV 4, TMV 3, VRI 3 and SVPR 1. Cluster 5 involved Sesamum alatum. From the cluster formation, it was denoted that the two wild species Sesamum malabaricum and Sesamum radiatum do not significantly differ from each other and hence fitted into the same cluster while Sesamum alatum stood out by differing from the other two wild species. Similarly, CO1 fell into a single cluster making it crucially contrasting from the other cultivated varieties. VRI 2 and VRI 3 did not mark the significant difference between each other hence are contained in the same cluster while the other varieties of Sesamum indicum were accommodated under a single cluster. Ultimately, it can be concluded that cultivated varieties of Sesamum indicum fell under three cluster and wild species into two clusters.

The genotypic and phenotypic correlation coefficients were estimated to assess the strength and direction of the relationship between yield and yield contributing traits. The former delineated a more stable heritable association while the latter explained a less stable observable association. The genotypic and phenotypic correlation coefficients between the yield and yield attributing traits, namely plant height, number of branches, days to first flowering, number of capsules per plant, number of seeds per capsule, capsule length, thousand seed weight, and single plant yield are presented (Table 1).

The present study revealed that seed yield per plant elucidated a positive and high significant correlation with a number of capsules per plant and thousand seed weight which disclosed these characteristics to be the vital yield components (Table 1). Similar results were reported by Saravanan *et al.* (2020) showing the number of capsules per plant and thousand seed weight exhibiting a positive and significant correlation with seed yield per plant. Thus, yield improvement in Sesame can be met by selecting plants with a greater number of capsules per plant and thousand seed weight.

Taking into account the inter association traits, the present study unveiled that number of capsules per plant and the number of seeds per capsule registered positive and high significant correlations with thousand seed weight and capsule length, respectively. Patil and Lokesha (2018) documented the same. Plant height recorded a significant and positive correlation with a number of branches and the number of seeds per capsule. Navaneetha et al.

(2019) and Umamaheswari et al. (2019) reported a positive significant correlation between plant height and a number of branches. Kalaiyarasi et al. (2019) established positive significant correlation between plant height and a number of capsules per plant. A number of branches were found to significant and positive correlation with days to fifty percent flowering. A similar association was described by Khairnar and Monpara (2013). From the genotypic and phenotypic correlation analysis, it was observed that seed yield per plant emphasized a positive and high significant correlation with the number of capsules per plant and thousand seed weight followed by inter correlation among number of capsules, number of seeds per capsule, capsule length, thousand seed weight, number of branches and days to fifty percent flowering. Hence these traits should be given paramount importance during selection for crop improvement in Sesame.

Path analysis depicting the direct and indirect effects of component characters on yield is given (Table 2) which emphasized that a number of capsules per plant had a high positive direct effect on seed yield per plant. Similar results were presented by Umamaheswari *et al.* (2019), Aye and Htwe (2019), and Saravanan *et al*. (2020). The characters such as thousand seed weight and a number of branches recorded less positive direct effect on yield. Abate (2018) revealed that a number of branches and thousand seed weight positively affected yield. The plant height marked a negligible positive direct effect on yield. Other attributes like days to first flowering, number of seeds per capsule, and capsule length showed a negative direct effect on seed yield per plant. Abate et al. (2015) reported the same for days to first flowering and the number of seeds per capsule. With respect to the indirect effect, thousand seed weight had a high positive indirect effect on seed yield per plant via a number of capsules per plant. The residue in path analysis demonstrated that other possible extrinsic attributes apart from the yield contributing traits are taken for the current study were exercised in association with the yield of the crop which requires to be identified.

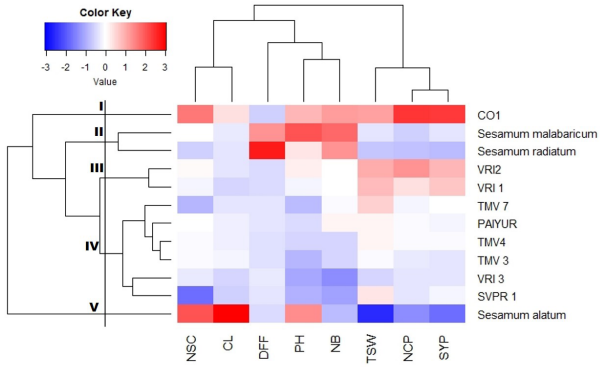

Fig 1. Heat map shows the relationship between cultivated and wild species of sesame

Fig 1. Heat Map shows the relationship between cultivated and wild species of sesame

Table 1. Phenotypic (upper) and genotypic (lower) correlation co efficient for yield and yield related traits in Sesame species

Traits	PH	NB	DFF	NCP	NSC	CL	TSW	SY
PH	1	0.6446*	0.3893	0.0234	0.6107*	0.4732	-0.328	0.0026
		0.6507*	0.4038	0.0154	0.6171	0.4678	-0.3388	-0.0108
NB		1	0.6078*	0.3091	0.1799	-0.186	0.2182	0.3443
			0.6606*	0.3059	0.1439	-0.2281	0.2111	0.3353
DFF			1	-0.3662	-0.1879	-0.1404	-0.3051	-0.3483
				-0.3663	-0.1855	-0.1314	-0.3041	-0.3467
NCP				1	0.23	-0.2844	0.798**	0.974**
					0.2214	-0.3006	0.7979**	0.9803**
NSC					1	0.7628**	-0.3419	0.1313
						0.7762**	-0.3647	0.1201
CL						1	-0.7343* *	-0.3699
							-0.7581**	-0.4027
TSW							1	0.8543**
								0.8574**
SY								1

* Correlation is significant at the 0.05 level, **Correlation is significant at the 0.01 level

PH-Plant Height, NB - Number of Branches per plant, DFF- days to first flowering,

NCP -Number of capsules per plant , NSC - Number of seeds per capsule, CL- Capsule length,

TSW- Thousand seed weight, SY- Single Plant Yield

Table 2. Path coefficient analysis of yield and yield related traits in Sesame species

Traits	PH	NB	DFF	NCP	NSC	CL	TSW	Correlation with SY
PH	0.0397	0.0663	-0.0434	0.0117	-0.0045	-0.0227	-0.0578	-0.0108
NB	0.0259	0.1018	-0.071	0.2325	-0.0011	0.0111	0.036	0.3353
DFF	0.0161	0.0673	-0.1075	-0.2784	0.0014	0.0064	-0.0519	-0.3467
NCP	0.0006	0.0312	0.0394	0.7601	-0.0016	0.0146	0.1362	0.9803**
NSC	0.0245	0.0147	0.0199	0.1683	-0.0074	-0.0377	-0.0622	0.1201
CL	0.0186	-0.0232	0.0141	-0.2285	-0.0057	-0.0486	-0.1294	-0.4027
TSW	-0.0135	0.0215	0.0327	0.6065	0.0027	0.0369	0.1706	0.8574**

Residual effect: 0.1374 Bold values are direct effect

PH-Plant Height, NB - Number of Branches per plant, DFF- days to first flowering,
NCP -Number of capsules per plant , NSC - Number of seeds per capsule, CL- Capsule length,
TSW- Thousand seed weight, SY- Single Plant Yield

CONCLUSION

From the association analysis, it can be deduced that the traits namely number of branches, number of capsules, and thousand seed weight recorded both significant positive correlation and higher direct effect on single plant yield. Hence, the selection process engrossing these traits would be rewarding to expand the yield in the Sesame crop improvement breeding program. The relationship between cultivated and wild species was concluded by a heat map which explained that cultivated varieties of Sesamum indicum fell into three clusters and wild species into two clusters depicting significant difference between the cultivated and wild species.

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Ethics statement

No specific permits were required for the described field studies because no human or animal subjects were involved in this research.

Originality and plagiarism

Authors should ensure that they have written and submit only entirely original works

Consent for publication

All the authors agreed to publish the content.

Competing interests

There were no conflict of interest in the publication of this content

Data availability

All the data of this manuscript are included in the MS. No separate external data source is required.

Author contributions

Sruthi S R, Kalaiyarasi R, Sasikala R and Sudha M contributed to the design and implementation of the research, to the analysis of the results and to the writing of the manuscript.

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