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Correlation and Path analysis of Seed Yield of Sesame (*Sesamum indicum* L.) under Summer Rice Fallow conditions

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ABSTRACT: Correlation and path analysis were performed to study the traits correlating and associating with seed yield of sesame under rice fallow conditions. Totally 95 genotypes of sesame were used in this study. The genotypes were raised in augmented design for evaluation under rice fallow conditions. The lines were raised under zero tillage and low input response conditions suitable for rice fallow ecosystem. The yield and yield attributing traits were recorded and analysed for correlation and path coefficient studies. Seed yield is positively correlated with germination percentage, plant height and number of capsules per plant, but negatively correlated with days to maturity. Number of capsules per plant positively correlated with plant height and negatively correlated with days to maturity. Shoot length and root length were positively correlated with seedling vigour index, but they were not correlated with plant height, and seed yield. Number of capsules per plant and plant height has direct effect on Seed yield, and days to maturity have indirect effect on seed yield. Hence, selection of superior progenies in segregating populations under rice fallow should be effected with higher plant height, long duration combined with more number of capsules to increase the yield. This study showed the component traits with their correlations and association for sesame genotypes adaptive conditions under rice fallow cultivation.

Keywords: Rice fallow, Zero tillage, low input response, correlation, path coefficient, Cauvery Delta Zone.

INTRODUCTION

Sesame is considered as the most important oil seed of the nation due the health benefits of the high quality oil content in seeds. Sesame (*Sesamum indicum* L.) is believed to be originated in India with much diversity available across all the states of the nation (Bedigian, 2010; Pham *et al*., 2010; Tripathy *et al*., 2019). It is grown in kharif as rainfed crop (June-July), with residual moisture and partially irrigated during rabi (October-November) and as summer irrigated crop (March-April). Rice fallow sesame cultivation is a promising cropping method which ensures increase in sesame area under production by utilizing the land meant for rice cultivation. Sesame is usually cultivated in upland conditions as rainfed or irrigated ecosystems. But utilizing the rice fields for successive cultivation of sesame as rice fallow crop not only increase the area of sesame, also increased production of oils in the country (Javeeda and Dhandapani 2022). Rice fallow sesame is not widely followed in rice growing regions of the nation, except in Kerala after rabi rice as summer rice fallow. The area under summer rice fallow is gradually decreasing or not stable every year in Kerala (Abijatha *et al*., 2017). In Tamil Nadu, sesame is cultivated after rice as successive crop during summer irrigated conditions in an area of 10000 ha of Thanjavur and Tiruchirappalli districts. Total rice cultivated area in Cauvery Delta Zone of Tamil Nadu is 14.4 lakh ha under which rice fallow pulses is grown in an area of 3.0 lakh ha as rice fallow pulses *viz*., blackgram and greengram. Being drought hardy and low input response crop, sesame can be successfully cultivated as rice fallow crop to increase the crop diversity, land use pattern and increase the oil seed production. Every year, Import of oils is being done from foreign countries. India is not self reliant in oil seeds production and oil requirement. Rice fallow sesame can be a successful and reliable cropping pattern to increase the area under oil seed production and increase the oil processing (Javeeda and Dhandapani 2022). The following varieties were released from Kerala Agricultural University to be cultivated under summer rice fallow conditions *viz*., Thilothama (kayamkulam-2), ACV-1 (Soma), ACV-2 (Surya), ACV-3 (Thilak), Thilathara, OMT-1165 and Thilarani (KAU, Agri-infotech portal). But in Tamil Nadu, there are no specific rice fallow

sesame varieties being evolved to suit the summer Rice fallow conditions. Though there is lot of scope for summer rice fallow cultivations in Cauvery delta Zone of Tamil Nadu, lack of availability of suitable summer rice fallow sesame variety is the bottleneck for introducing the summer rice fallow sesame cultivations. Cauvery Delta Zone is characteristics with mono crop of rice (Rice-Rice in larger proportions, Rice-Rice-Rice is becoming recent trends among farmers of CDZ) results in excessive fertilizer usage and other chemical inputs usage for rice cultivation. Mono crop of rice narrow downs the agro diversity of CDZ regions and it has become serious issue towards sudden out break of pests and diseases. In long term, it will result in reduction of rice productivity by reduction of soil fertility due to erosion and depletion of nutrients. Sesame cultivation ensures stable income to the farmers, as the marketability of sesame seeds highly remunerative (Kumarasamy and Sekar 2017). To evolve suitable summer rice fallow sesame variety for cultivation, cultivation conditions, correlations and character associations are pre requisites in crop improvement programs to select better performing superior progenies in segregating generations. Seed yield of sesame positively correlated with plant height, number of capsules per plant, number of seeds per plant, days to maturity and 1000 seed weight, where as oil content is negatively correlated (Parameshwarappa *et al.*, 2009). Correlation studies helps to identify the suitable donors and recipient parents from the diverse germplasm lines studying their traits which influence the yield. Evaluation of particular agro ecological conditions will be highly helpful to select a genotype with stable phenotypic expression with less environmental interactions and inheritance (Abate, 2018). Rice fallow sesame cultivation is having lot of scopes to increase the area under sesame, also to utilize the rice soils under sesame cultivation to increase the agro diversity of Cauvery Delta Zone of Tamil Nadu. Hence, the present study aimed to study the correlation of traits with seed yield and their association to select the traits and suitable donors for developing high yielding sesame varieties adapted to rice fallow conditions *viz*., zero/ minium tillage conditions, low/no input conditions and with less irrigations. In this study, 95 sesame genotypes were raised under summer rice fallow conditions to study the correlation and character association for seed yield.

MATERIALS AND METHODS

A. Screening under rice fallow conditions

Paddy variety, improved white ponni was raised in field number, F1 of F block of Central, Farm, Agricultural Engineering College and Research Institute, TNAU, Kumulur during Late Samba 2019-20 (October-February). After mechanical harvest of paddy crop, the paddy straw was left it in the field. The field was irrigated once and drained properly. The field was allowed to reduce the wetness of the soil considerably. Under optimum wetness of the soil, seeds of the sesame entries were sown near the rice stubbles by mixing seeds with fine sand. Seeds germinated 5 days after sowing (Fig. 1). Excess seedlings were thinned out and one seedling was allowed to grow.

B. Details of sesame lines used in the experiment

The entries constituted with germplasm lines and popular varieties received from Regional Research Station, TNAU, Viridhachalam, local land races collected from lalgudi (Tricy dt), and Trishnagiri district were used. The eco types of Thirukkattupalli local were collected from Sembarai, Thirukkattupalli, Lalgudi (Trichy dt) was purified by pureline selection and used in the experiment. The popular varieties used in the study are *viz*., VRI2, Thirukkattupalli Local, TMV4, TMV6 and Paiyur 1.

C. Experimental design and Statistical analysis

The experimental trial was laid out in augmented design with 5 blocks. Each block consisted of 19 varieties. 5 checks were used viz., VRI2, Thirukkattupalli Local, TMV4, TMV6 and Paiyur 1. Statistical analysis was performed with R statistical package.

RESULTS AND DISCUSSION

This study was conducted to study correlation between seed yield, yield attributing traits of rice fallow sesame. Character association was studied to find out the direct and indirect effects on seed yield of rice fallow sesame. The following traits were studied for correlation and path coefficient analysis *viz*., shoots length, root length, germination percentage, seedling vigour index, plant height, 1000 seed weight, number of capsules per plant with seed yield.

In correlation analysis of rice fallow sesame lines, seed is positively and highly correlated with germination percentage, plant height, number of capsules per plant (Table 1). It is known that higher germination percentage is required to establish optimum plant population in rice fallow cropping conditions to have more yields. There is no proper leveling and uniform moisture conditions. Seeds are broadcast in residual moisture conditions to germinate and establish. Hence, germination under rice fallow conditions should be important selection criteria while selecting the rice fallow responsive genotypes in segregating populations. Plant height is positively correlated with seed yield indicating more number of capsules can be produced if plant height is more with more number of branches. Number of capsules is very important criteria which determine the seed yield under low input and low moist conditions. 1000 seed weight did not have any correlations on seed yield, as seed size did not determine the yield in sesame. Days to 50% flowering and days to maturity negatively correlated with seed yield (Table 1).

In path co efficient analysis of the traits studied, there is direct effect of number of capsules (0.9516) on seed yield indicating the character association on yield. Germination percentage had moderate indirect effect on number of capsules towards seed yield (Table 2).

Correlation and path analysis of rice fallow sesame revealed that the following traits are very important for selection of higher yield response genotypes *viz.*, germination percentage under rice fallow conditions, plant height and number of capsules. Direct selection of

these traits will result in identification of higher yield response genotypes of rice fallow sesame suitable for summer rice fallow conditions with low input responses.

Number of capsules per plant, number of seeds per capsule, number of branches per plant had significantly positive effect on seed yield of sesame from the correlation and path analysis study with 45 sesame genotypes. Direct selection of these traits would improve the seed yield (Gnanasekaran *et al.,* 2008). Number of capsules per plant, number of seeds per capsules, and 1000 seed weight positively correlated with seed yield. Days to 50% flowering, and days to maturity were negatively correlated with seed yield. Similarly, number of capsules per plant had positive direct effect on seed yield, 1000 seed weight, plant height had positive direct and indirect effects on seed yield of sesame in a study conducted with 66 accessions (Srikanth and Ghodke 2022). The results are concordance with the previously published reports (Ibrahim *et al.*, 2012; Saipriya *et al.*, 2018; Hukumchand and parameshwarappa 2019; Kehie *et al.,* 2020). Similar results obtained from the study in which the sesame lines were screened under upland shaded conditions using 33 accessions in Kerala to evaluate for variability and to study the phenotypic correlations and path coefficient analysis to study the direct and indirect effects on seed yield and the results of the studies are in concordance with the previously published reports (Daniya *et al.,* 2013; Abhijatha *et al.,* 2017; Patil *et al.,* 2018; Kalaiyarasi *et al*., 2019). Seed yield was positively correlated with number of capsules per plant, number of seeds per capsules, 1000 seed weight and plant height in a study conducted in summer irrigated sesame crop using 24 hybrids evolved by line x tester analysis (Disowja *et al*., 2020). Similar results were in accordance with the published report (Umamaheswari *et al.,* 2019; Kumar *et al*., 2022).

Screening and evaluating lines under summer rice fallow conditions narrowed down the genetic variability due to poor responses of most of the lines tested under this study. The adaptive traits under rice fallow conditions characterized by growth, development under zero tillage conditions, low / no input conditions and moisture stress during growth period. It is also important that the present study will be helpful to select superior progenies of sesame suitable for rice fallow conditions. Correlation and path analysis revealed the characters positively and negatively correlated with seed yield *viz*., germination percentage, plant height and number of capsules, negatively correlated traits *viz.,* days to 50% flowering and days to maturity. Germination percentage, plant height and number of capsules had positive direct effects on seed yield and days to 50% flowering and days to maturity non significant indirect effect on yield.

Table 1: Details of sesame accessions used in the study.

Sr. No.	Name of the accession	Source
1.	VRI(SV)2	Regional Research Station (RRS), TNAU, Viridhachalam
2.	JLT26	RRS, TNAU, Viridhachalam
3.	Mettupatti local	Collection from Mettupatti village, lalgudi block, Trichy Dt
4.	JT-8	RRS, TNAU, Viridhachalam
5.	Sengaraiyur local	Collection from Sembarai village, lalgudi block, Trichy Dt
6.	Uma	RRS, TNAU, Viridhachalam
7.	Tilak	RRS, TNAU, Viridhachalam
8.	GT-2	RRS, TNAU, Viridhachalam
9.	Nirmala	RRS, TNAU, Viridhachalam
10.	TKG306	RRS, TNAU, Viridhachalam
11.	Paiyur 1	RRS, TNAU, Viridhachalam
12.	CO1	RRS, TNAU, Viridhachalam
13.	TKG55	RRS, TNAU, Viridhachalam
14.	JT-2	RRS, TNAU, Viridhachalam
15.	Kanak	RRS, TNAU, Viridhachalam
16.	VS-01-034	RRS, TNAU, Viridhachalam
17.	Punavasal local	Collection from Punnavasal village, lalgudi block, Trichy Dt
18.	Vinayak	RRS, TNAU, Viridhachalam
19.	T13	RRS, TNAU, Viridhachalam
20.	Tarun	RRS, TNAU, Viridhachalam
21.	T4	RRS, TNAU, Viridhachalam
22.	Pragathi	RRS, TNAU, Viridhachalam
23.	RT54	RRS, TNAU, Viridhachalam
24.	Varagha	RRS, TNAU, Viridhachalam
25.	N32	RRS, TNAU, Viridhachalam
26.	Chandana	RRS, TNAU, Viridhachalam
27.	RT 103	RRS, TNAU, Viridhachalam
28.	TKG22	RRS, TNAU, Viridhachalam
29.	VS-07-023	RRS, TNAU, Viridhachalam
30.	NIC 8502	RRS, TNAU, Viridhachalam
31.	NIC8509	RRS, TNAU, Viridhachalam
32.	RT125	RRS, TNAU, Viridhachalam
33.	Rajeswari	RRS, TNAU, Viridhachalam
34.	Thilotama	RRS, TNAU, Viridhachalam
35.	RT-127	RRS, TNAU, Viridhachalam
36.	E-8	RRS, TNAU, Viridhachalam
37.	RT-146	RRS, TNAU, Viridhachalam
38.	Sirumayankudi local	Collection from Sirumayankudi village, lalgudi block, Trichy Dt

39.	Thirukkattupalli local	Collection from Tirukkattupalli region, Thirukkattupalli block, Thanjavur Dt
40.	PKDS-12	RRS, TNAU, Viridhachalam
41.	Sheker	RRS, TNAU, Viridhachalam
42.	Ariyur local	RRS, TNAU, Viridhachalam
43.	Krishna	RRS, TNAU, Viridhachalam
44.	NIC7939	RRS, TNAU, Viridhachalam
45.	Anbil local	RRS, TNAU, Viridhachalam
46.	NIC8315	RRS, TNAU, Viridhachalam
47.	NIC7934	RRS, TNAU, Viridhachalam
48.	NIC5432	RRS, TNAU, Viridhachalam
49.	NIC74185	RRS, TNAU, Viridhachalam
50.	IC43177	RRS, TNAU, Viridhachalam
51.	IC4316	RRS, TNAU, Viridhachalam
52.	RJS78	RRS, TNAU, Viridhachalam
53.	RJS80	RRS, TNAU, Viridhachalam
54.	DS-1	RRS, TNAU, Viridhachalam
55.	N8	RRS, TNAU, Viridhachalam
56.	Hima	RRS, TNAU, Viridhachalam
57.	VRI(SV)1	RRS, TNAU, Viridhachalam
58.	Usha	RRS, TNAU, Viridhachalam
59.	KM6	RRS, TNAU, Viridhachalam
60.	KM8	RRS, TNAU, Viridhachalam
61.	KM10	RRS, TNAU, Viridhachalam
62.	KMS-4-396	RRS, TNAU, Viridhachalam
63.	KMS-4--393	RRS, TNAU, Viridhachalam
64.	ES-13101	RRS, TNAU, Viridhachalam
65.	RJS108	RRS, TNAU, Viridhachalam
66.	TMV7	RRS, TNAU, Viridhachalam
67.	SWETHA	RRS, TNAU, Viridhachalam
68.	G-TIL-1	RRS, TNAU, Viridhachalam
69.	JET-7	RRS, TNAU, Viridhachalam
70.	PRACHI	RRS, TNAU, Viridhachalam
71.	EC-303446	RRS, TNAU, Viridhachalam
72.	07-Oct	RRS, TNAU, Viridhachalam
73.	ES-31	RRS, TNAU, Viridhachalam
74.	TMV-4	RRS, TNAU, Viridhachalam
75.	GOPI	RRS, TNAU, Viridhachalam
76.	SI-1248	RRS, TNAU, Viridhachalam
77.	IS-39-A	RRS, TNAU, Viridhachalam
78.	NIC-8317	RRS, TNAU, Viridhachalam
79.	IS-153A	RRS, TNAU, Viridhachalam
80.	IS-562-B	RRS, TNAU, Viridhachalam
81.	IS-80-A	RRS, TNAU, Viridhachalam
82.	SI-506-B	RRS, TNAU, Viridhachalam
83.	RJS-175	RRS, TNAU, Viridhachalam
84.	TC-25	RRS, TNAU, Viridhachalam
85.	GT-10	RRS, TNAU, Viridhachalam
86.	GRT-8359	RRS, TNAU, Viridhachalam
87.	OMT-21-A	RRS, TNAU, Viridhachalam
88.	Thinniyam local	Collection from Thinniyam village, lalgudi block, Trichy Dt
89.	Sengaraiyur local	Collection from Sengaraiyur village, lalgudi block, Trichy Dt
90.	Ariyur local	Collection from Ariyur village, lalgudi block, Trichy Dt
91.	Sembarai local	Collection from Sembarai village, lalgudi block, Trichy Dt
92.	Mettukkudi local	Collection from Mettukkudi village, lalgudi block, Trichy Dt
93.	Anbil local	Collection from Anbil village, lalgudi block, Trichy Dt
94.	Thilthara	RRS, TNAU, Viridhachalam
95.	OMT-21-A	RRS, TNAU, Viridhachalam

Table 2: Correlation analysis of seed yield and attributing traits in rice fallow sesame.

	SL	RL	GP	SVI	TSW	PH	DFF	DM	NC	SY
SL	1.00	0.34	0.08	0.33***	-0.05	-0.05	0.09	-0.01	-0.07	-0.06
RL		1.00	-0.08	0.55***	-0.03	-0.07	-0.05	0.03	0.08	0.03
GP			1.00	0.47***	0.09	0.04	-0.15	0.08	0.22*	0.25*
SVI				1.00	0.03	-0.04	-0.06	0.01	0.18	0.15
TSW					1.00	0.09	-0.12	0.18	-0.09	-0.07
PH						1.00	0.04	-0.02	0.27**	0.18
DFF							1.00	-0.02	-0.08	-0.08
DM								1.00	-0.26***	-0.29**
NC									1.00	0.92***
SY										1.00

SL: Shoot length; RL: Root length; GP: Germination percentage; SVI: Seedling vigour index; TSW: 1000 seed weight; PH: Plant height (cm); DFF: Days to 50% flowering; DM: Days to maturity; NC: Number of capsules per plant; SY: Seed yield.

Table 3: Path coefficient analysis in rice fallow sesame.

	SL	RL	GP	SVI	TSW	PH	DFF	DM	NC
SL	**0.0124**	0.0003	0.0061		-0.0005	0.0048	0.0007	0.0006	-0.0761
RL	-0.0042	**-0.0008**	-0.0069	-0.0304	-0.0003	0.0064	-0.0002	-0.0017	0.0381
GP	0.0010	0.0001	**0.0762**	-0.0254	0.0011	-0.0056	-0.0012	-0.0045	0.2284
SVI	0.0041	-0.0004	0.0350	**-0.0552**	0.0002	0.0040	-0.0004	-0.0006	0.1332
TSW	-0.0007	0.0000	0.0099	-0.0011	**0.0086**	-0.0168	-0.0014	-0.0102	0.1618
PH	-0.0007	0.0001	0.0053	0.0028	0.0018	**-0.0802**	-0.0003	0.0006	0.3807
DFF	0.0012	0.0000	-0.0129	0.0028	-0.0017	0.0032	**0.0071**	0.0011	-0.1808
DM	-0.0001	0.0000	0.0061	-0.0006	0.0016	0.0008	-0.0001	**-0.0568**	-0.1808
NC	-0.0010	0.0000	0.0183	-0.0077	0.0015	-0.0321	-0.0014	0.0108	**0.9516**

Residual effect	0.104169

CONCLUSIONS

Summer rice fallow sesame cultivation is a promising cropping pattern to diversify the rice based cropping system and increase the area of sesame production towards oilseed self sufficiency. To develop summer rice fallow responsiveness in sesame, the characters correlated and having positive direct and indirect effects have to be selected in segregating generations viz., higher germination percentage under rice fallow conditions, plant height, number of capsules per plant.

FUTURE SCOPE

The evaluated sesame materials for correlation and path analysis studies will be used for developing high responsive and stable yield summer rice fallow sesame varieties suited to the Cauvery Delta Zone of Tamil Nadu.

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