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Correlation and path analysis for seed yield and its attributing traits in white seeded sesame (*Sesamum indicum* L.)

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Abstract
Correlation coefficient analysis and path analysis were carried out to determine the effects of fourteen traits as components of seed yield in thirty white seeded sesame genotypes. The genotypes were evaluated in Randomised Block Design with three replications during summer season 2019-2020 at the ORARS, Kayamkulam. Correlation among the traits revealed that seed yield per plant was positively associated with number of capsules per plant, dry matter production, plant height, number of capsules per leaf axil, leaf area, primary branches per plant, number of seeds per capsule, capsule length and days to 50 per cent flowering suggesting that selection made on the basis of these characters will assist in enhancing the seed yield. The path coefficient analysis of different characters contributing towards seed yield per plant showed highly positive direct effect by characters *viz.*, number of capsules per plant, number of seeds per capsule, number of capsules per leaf axil and plant height. Indirect positive effect was showed by number of capsules per plant *via* plant height, primary branches per plant, number of capsules per leaf axil, capsule length, leaf area and dry matter production.

Keywords: Sesame, phenotypic and genotypic correlation and path coefficient analysis

1. Introduction

Sesame (*Sesamum indicum* L., 2n=2x=26), popularly known as "Queen of oil seeds" is a pioneer among the domesticated oil seed crops. Sudan (981,000 tons) is the world's largest producer of sesame followed by Myanmar. Even though sesame is originated in Africa, India is considered to be the major centre of genetic diversity (Maiti *et al*., 2012) [8]. India is the third largest sesame-producing country in the world with total annual production of 746,000 tons. In India, sesame is cultivated in an area of 17.30 lakh ha with a productivity of 431 kg/ha. India shares 12.4 per cent of global sesame production (FAOSTAT, 2020) [3].

Confectionary value of sesame seed and superior quality of its oil has enabled it to emerge as an important commodity in the international trade. Sesame serves diverse value chains. It is useful in the food, feed, confectionery and baking industry. Sesame oil has medicinal and pharmaceutical value and its seeds are industrially processed mainly to supply cooking oil, tahini, halvah, cosmetic oils etc. While the seed cake is used for livestock feed. Sesame seed yield is strongly associated with several other component characters. The relationship of yield with other characters is of great significance while formulating any selection program for crop improvement. Selection based on only seed yield in white seeded sesame without considering the component characters is not effective since seed yield is a dependent character influenced by several other independent characters. Keeping these aspects in view, the present investigation was undertaken to study phenotypic and genotypic correlation and path coefficient analysis.

2. Materials and Methods

The present study was conducted at ORARS (Kerala Agricultural University) Kayamkulam, Kerala, India, during summer season 2019-20. The experiment was laid out with thirty white seeded sesame genotypes in a Randomized Block Design (RBD) with three replications. Recommended agronomic practices were followed during crop growth period as per the "Package of Practices recommendations" of Kerala Agricultural University (KAU, 2016).

The genotypes were evaluated for the following traits: days to 50 per cent flowering, days to maturity, plant height, primary branches per plant, number of capsules per leaf axil, number of capsules per plant, capsule length (cm), number of seeds per capsule, 1000 seed weight, leaf area, dry matter production, seed yield per plant, oil content (%) and protein content (%).

The genotypic and phenotypic correlation coefficients were calculated as described by Singh and Choudhary (1985) [13] and as per formula given by Johnson *et al.,* (1955) [4] and path analysis as per Dewey and Lu (1959) [1].

3. Results and Discussion

The association among yield and yield contributing traits including quality characters were studied by estimating genotypic and phenotypic correlation coefficients. The results of genotypic and phenotypic correlation coefficients which were estimated among the fourteen characters are presented in the Table 1 and Table 2. Seed yield per plant had highly significant and positive phenotypic and genotypic correlation with number of capsules per plant (0.863/0.859), dry matter production (0.610/0.747), plant height (0.438/0.578), number of capsules per leaf axil (0.419/0.460), leaf area (0.361/0.442), primary branches per plant (0.265/0.416), number of seeds per capsule (0.406/0.395) and capsule length (0.286/0.369). Patil and Lokesha (2018) [10] and Sasipriya *et al.* (2018) [12] already reported significant and positive correlation of seed yield with number of capsules per plant, number of seeds per capsule, primary branches per plant and capsule length. Kalaiyarasi *et al*., (2019) [5], Disowja *et al.,* (2020) [2], Navaneetha *et al*., (2020), Saravanan *et al*., (2020) [11] and Takele *et al*. (2021) [15] already documented significant and positive correlation of seed yield with plant height. According to Patil and Lokesha (2018) [10], Sasipriya *et al.,* (2018) [12], Umamaheshwari *et al.,* (2019) and Disowja *et al*., (2020) [2] thousand seed weight had significant and positive correlation with seed yield. The positive correlation of days to maturity with the seed yield per plant was obtained by Kumar *et al.,* (2022) [6]. But in the present investigation, 1000 seed weight and days to maturity was non significantly correlated with seed yield per plant which is in accordance with the results of Kumari *et al.,* (2019). Kindeya *et al*., (2017) and Disowja *et al*., (2020) [2] reported significant negative correlation of days to maturity with seed yield. In the present study days to 50 per cent flowering was found to have significant positive genotypic correlation with seed yield per plant (0.282). However, according to Kalaiyarasi *et al.,* (2019) [5] and Kindeya *et al.,* (2017), days to 50 per cent flowering showed significant negative association with seed yield. Oil content showed significant and negative genotypic correlation with seed yield per plant (- 0.230) at genotypic level. Earlier reports of Swathy (2018) [14] support these findings.

For efficient indirect selection for seed yield on the basis of yield attributes, estimates of interrelationships among yield components is essential as it provides more reliable information for efficient selection. Days to 50 per cent flowering had significant positive correlation with days to maturity, leaf area and primary branches per plant at both phenotypic and genotypic levels. Kumari *et al*., (2019) also observed positive association of days to 50 per cent flowering with days to maturity and number of primary branches per plant. Significant positive correlation was found between plant height and dry matter production, leaf area, number of capsules per plant, primary branches per plant, capsule length and protein content at both phenotypic and genotypic level. Plant height exhibited significant negative association with oil content. Vinoth *et al*., (2018) and Takele *et al.,* (2021) [15] already reported positive and highly significant correlation of plant height with the number of branches per plant and number of capsules per plant. Primary branches per plant had significant negative association with number of capsules per leaf axil followed by oil content. However, days to maturity also had significant and positive correlation with primary branches per plant at genotypic level. Number of capsules per plant had a significant negative association with oil content at phenotypic and genotypic level was in concordance with the findings of Swathy (2018) [14]. 1000 seed weight recorded negative and significant association with number of seeds per capsule. Days to maturity expressed significantly positive association with 1000 seed weight at genotypic level. However, at phenotypic level it was non significantly positive. The trait leaf area showed significantly negative phenotypic and genotypic correlation with oil content and number of capsules per leaf axil. At genotypic and phenotypic level, dry matter production showed negative association with oil content. Protein content expressed significantly positive phenotypic and genotypic correlation with capsule length followed by dry matter production, number of capsules per leaf axil, plant height and primary branches per plant.

The genotypic correlation coefficients of seed yield per plant with yield contributing characters were partitioned into different components to find the direct and indirect effect of each character to yield (Table 3). The traits *viz.*, plant height, primary branches per plant, number of capsules per leaf axil, number of capsules per plant, capsule length, number of seeds per capsule, leaf area and dry matter production which manifested high genotypic correlation with yield were selected for path analysis. Path diagram showing the direct and indirect effects of the component characters on seed yield per plant is given in Fig 1. Path coefficient analysis revealed that number of capsules per plant (0.75762) recorded the highest positive direct effect on seed yield per plant followed by number of seeds per capsule, number of capsules per leaf axil and plant height. Kumari *et al*., (2019), Navaneetha *et al.,* (2019) [9] and Vinoth *et al.,* (2018) already documented the direct high positive significance of number of capsules per plant on seed yield per plant.

The characters *viz.,* capsule length, primary branches per plant and leaf area showed negligible positive direct effect on seed yield per plant. While dry matter production exhibited low negative direct effect on seed yield per plant. The traits plant height, primary branches, Number of capsules per leaf axil, capsule length, leaf area and dry matter production had positive indirect on seed yield per plant mainly through high indirect effect of number of capsules per plant. Similar findings were observed by Sasipriya *et al.,* (2018) [12], Vinoth *et al*., (2018), Navaneetha *et al.,* (2019) [9], Kalaiyarasi *et al.,* (2019) [5], Umamaheshwari *et al.,* (2019) and Disowja *et al.,* (2020) [2]. The residual effect obtained was 0.1301 which indicates that selected traits explain the total correlation well and the remaining characters have only minor contribution in the variability of seed yield.

Table 1: Genotypic correlation coefficients

	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13	X14
X1	1	0.813**	0.096	0.415**	-0.059	0.246*	0.002	0.141	0.1	0.284**	0.084	0.282**	0.121	-0.204
X2		1	-0.049	0.404**	-0.291**	-0.300**	-0.196	0.129	0.228*	0.118	-0.252*	-0.165	0.233*	-0.103
X3			1	0.663**	0.031	0.581**	0.519**	0.129	0.075	0.634**	0.845**	0.578**	-0.286**	0.248*
X4				1	-0.394**	0.370**	0.398**	0.365**	-0.055	0.625**	0.542**	0.416**	-0.382**	0.243*
X5					1	0.372**	0.117	0.166	0.095	-0.242*	0.265*	0.460**	0.163	0.284**
X6						1	0.252*	0.092	-0.091	0.542**	0.798**	0.859**	-0.238*	0.007
X7							1	0.193	0.177	0.270*	0.509**	0.369**	-0.078	0.365**
X8								1	-0.315**	-0.017	0.191	0.395**	-0.237*	0.076
X9									1	0.098	0.039	0.173	0.115	0.195
X10										1	0.566**	0.442**	-0.404**	-0.115
X11											1	0.747**	-0.302**	0.329**
X12												1	-0.230*	0.119
X13													1	0.158
X14														1

X1 Days to 50 per cent flowering
X2 Days to Maturity
X3 Plant height (cm)
X4 Primary branches per plant
X5 Number of capsules per leaf axil
X6 Number of capsules per plant
X7 Capsule length (cm)
X8 Number of seeds per capsule
X9 1000 seed weight
X10 Leaf area
X11 Dry matter production
X12 Seed yield per plant (g)
X13 Oil content (%)
X14 Protein content (%)

** Significant at 1 percent level
* Significant at 5 percent level

Table 2: Phenotypic correlation coefficients

	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13	X14
X1	1	0.487**	0.087	0.228*	-0.089	0.113	0.004	0.101	0.07	0.232*	0.076	0.147	0.146	-0.165
X2		1	-0.06	0.197	-0.213*	-0.173	-0.109	0.133	0.166	0.073	-0.155	-0.066	0.174	-0.071
X3			1	0.440**	0.016	0.460**	0.439**	0.036	0.078	0.555**	0.705**	0.438**	-0.259*	0.230*
X4				1	-0.321**	0.226*	0.284**	0.273**	-0.031	0.511**	0.376**	0.265*	-0.243*	0.211*
X5					1	0.351**	0.105	0.148	0.096	-0.240*	0.238*	0.419**	0.135	0.261*
X6						1	0.187	0.115	-0.089	0.450**	0.663**	0.863**	-0.212*	0.01
X7							1	0.159	0.182	0.238*	0.457**	0.286**	-0.062	0.338**
X8								1	-0.271**	-0.007	0.165	0.406**	-0.194	0.061
X9									1	0.078	0.02	0.166	0.116	0.182
X10										1	0.548**	0.361**	-0.379**	-0.108
X11											1	0.610**	-0.271**	0.299**
X12												1	-0.194	0.111
X13													1	0.152

X1 Days to 50 per cent flowering
X2 Days to Maturity
X3 Plant height (cm)
X4 Primary branches per plant
X5 Number of capsules per leaf axil
X6 Number of capsules per plant
X7 Capsule length (cm)
X8 Number of seeds per capsule
X9 1000 seed weight
X10 Leaf area
X11 Dry matter production
X12 Seed yield per plant(g)
X13 Oil content (%)
X14 Protein content (%)

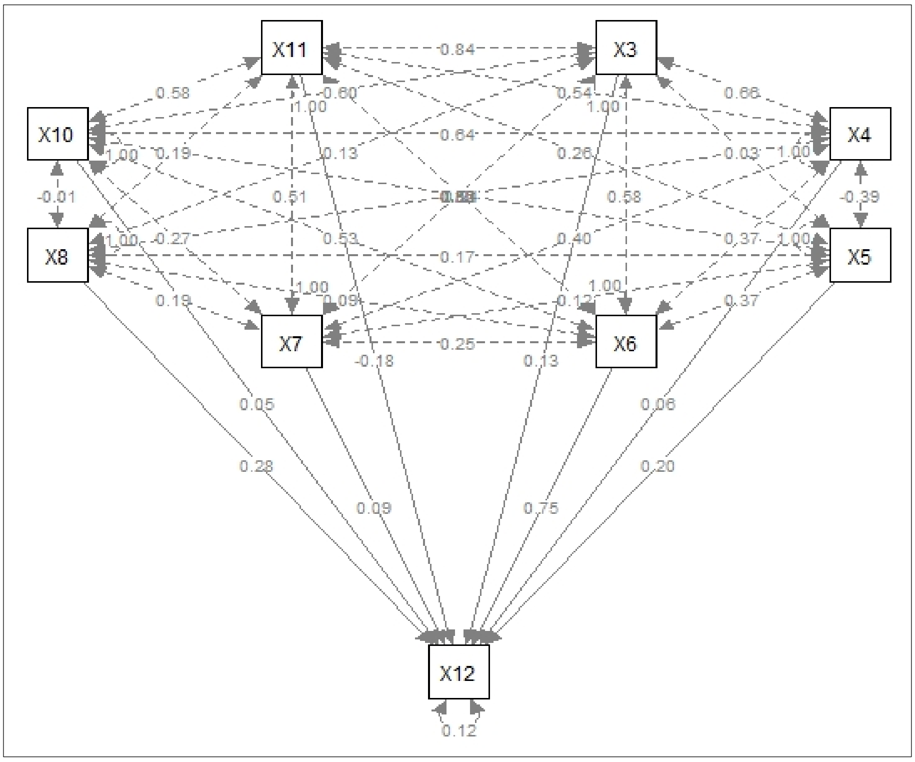
** Significant at 1 percent level
* Significant at 5 percent level

Table 3: Path analysis (direct diagonal / indirect off diagonal)

	X3	X4	X5	X6	X7	X8	X10	X11	Genotypic correlation co-efficiencies
X3	0.14346	0.04185	0.00622	0.43982	0.04484	0.03464	0.02149	-0.15399	0.578**
X4	0.09505	0.06317	-0.07904	0.28052	0.03436	0.09816	0.02297	-0.09873	0.416**
X5	0.00445	-0.02492	0.20036	0.28215	0.01013	0.04471	-0.0087	-0.04829	0.460**
X6	0.08328	0.02339	0.07462	0.75762	0.02174	0.02467	0.01909	-0.14545	0.859**
X7	0.0745	0.02513	0.02352	0.19075	0.08634	0.05195	0.00947	-0.09276	0.369**
X8	0.01845	0.02303	0.03326	0.06941	0.01666	0.26927	-0.00019	-0.03486	0.395**
X10	0.08637	0.04065	-0.0488	0.40517	0.02289	-0.00144	0.0357	-0.10495	0.442**
X11	0.12117	0.03421	0.05307	0.60444	0.04393	0.05149	0.02055	-0.18231	0.747**

Residual effect = 0.1301

X3 Plant height (cm)
X4 Primary branches per plant
X5 Number of capsules per leaf axil
X6 Number of capsules per plant
X7 Capsule length (cm)
X8 Number of seeds per capsule
X10 Leaf area
X11 Dry matter production



X3	Plant height (cm)	X7	Capsule length (cm)
X4	Primary branches per plant	X8	Number of seeds per capsule
X5	Number of capsules per leaf axil	X10	Leaf area
X6	Number of capsules per plant	X11	Dry matter production

Fig 1: Path diagram

4. Conclusions

Positive and significant correlations of seed yield per plant was recorded with number of capsules per plant, dry matter production, plant height, number of capsules per leaf axil, leaf area, primary branches per plant, number of seeds per capsule, capsule length and days to 50 per cent flowering which revealed that the selection based on these traits would ultimately improve seed yield. Path coefficient analysis revealed that high positive direct effect on seed yield per plant was exerted by the traits *viz.*, number of capsules per plant, number of seeds per capsule, number of capsules per leaf axil and plant height and therefore these traits are the major yield contributing characters to be given selection pressure for improving yield. It is also suggested that hybridization of genotypes possessing combination of above characters could be used in breeding program in order to obtain high yielding segregants of white seeded sesame.

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