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Character Association and Path Analysis for Quantitative Traits in Advanced Breeding Lines of Sesame (*Sesamum indicum* L.)

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A B S T R A C T

Association and path coefficient analysis was computed on 96 genotypes of Sesamum (*Sesamum indicum* L.). Seed yield was positively correlated with plant height, number of branches per plant, number of capsules per plant, capsule length and 1000 seed weight. Selection based onplant height, number of branches per plant, number of capsules per plant and capsule length would increase seed yield. Path analysis indicated that number of capsules per plant had the maximum direct effect followed by plant height, capsule length and height to first capsule.

Introduction

The word sesame derived from Latin word '*sesamum*' and Greek word '*sesamon*' which means seed or fruit of sesame plant. Sesame (*Sesamum indicum.* L), also known as 'ellu' in 'Kannada', 'til' in Hindi and 'nuvvulu' in Telugu, is an ancient crop known to mankind. It is an indigenous crop of India after groundnut and brassica oilseeds. Weiss (1883) and several other were having view that it was originated in south western Africa. In Africa most of the cultivated and wild species of sesame occurs. It might have introduced through countries like Indonesia and Malaysia before Aryan dynasty. *Sesamum indicum*. L, is one among total 13 genera. It belongs to the family Pedaliaceae and order Tubiflorae. There are 36 species including the cultivated species (*Sesamum indicum* L.) which has chromosome number 2n=26.

The level of variability and the magnitude of diversity for useful traits present in the material is important for development of improved varieties/hybrids. Genetic variability is more important to a breeder to develop improved material and for successful hybridization programme. Always yield is a complex character which is controlled by numerous genes (polygenic), which is affected by environment by a greater extent. So

emphasis should be given to traits which are less affected by environment. Apart from splitting of total variance into phenotypic and genotypic, it's also essential to be aware of the level of correlation between various traits affecting the yield component. In order to partition correlation coefficients using path coefficient analysis, which helps to every component part affecting yield. Path co-efficient analysis measures the direct influence of a variable upon yield and permits the partitioning of the correlation coefficient into components of direct and indirect effects. The present study was therefore conducted to investigate the nature of correlations by path analysis for seed yield.

Materials and Methods

Ninety six advanced breeding lines along with checks (JTS-8, TKG-22, GT-10 and DS-5) were evaluated at Main Agricultural Research Station, University of Agricultural Sciences, Dharwad (Karnataka) during *kharif*, 2018 in a Randomized Complete Block Design with two replications. Each genotype was sown in a single row of 3 m length at a distance of 30 cm between the rows and 15 cm between the plants within the rows. Five plants in each row were selected at random and the data on ten characters viz., days to 50 per cent flowering, days to maturity, plant height (cm), plant height to first capsule (cm), number of branches per plant, number of capsules per plant, capsule length (cm), 1000 seed weight (g), oil content (%) and seed yield per plant (g) were analyzed and correlations were computed. The pathco-efficient analysis at genotypic level was computed by Deway and Lu (1959) procedure.

Results and Discussion

At both phenotypic and genotypic level, traits such as plant height, number of capsules, number of branches, height to first capsule, capsule length, oil content and 1000 seed weight had positive significant association with seed yield per plant (Table. 1 and 2).The character plant height has showed significant positive correlation with seed yield/plant both at genotypic as well as at phenotypic level concluding that plant height is a dependable measure of yield and choosing the tall lines would be productive (Fig. 1). These results are in accordance with Sudhakar *et al.,* (2007), Sumathi *et al.,* (2007), Yingzhong and Yishou (2002), Engin Yol *et al.,* (2010), Ibrahim and Khidir (2012), Ammara Fazal *et al.,* (2015), Yirga (2017) and Atul Singh *et al.,* (2018).

The trait capsules per plant had highly significant positive association with seed yield per plant both at genotypic and phenotypic level designating that this trait is dependable criteria for choosing of higher yielding lines. The results are in accordance with Sudhakar *et al.,* (2007), Sumathi *et al.,* (2007), Engine Yol *et al.,* (2010). One of the study by Ammara Fazal *et al.,* (2015) has indicated that there is an increase in yield if we select high capsule bearing line. Significant positive association observed between capsule length with seed yield per plant both at genotypic as well as at phenotypic level is a dependable measure while selecting high yielding lines, the outcomes are in consonance with Sudhakar *et al.,* (2007), Parameshwarappa *et al.,* (2009) and Baoreima *et al.,* (2016).

There was positive significant association between height to first capsule and seed yield pert plant. The results are in consonance with Ibrahim and Khidir (2012). Generally, less height to first capsule will be preferred since plant has less height to first capsule then more number of capsules can be formed at above plant part which leads to increase in yield level. The trait 1000 seed weight had positive significant association with seed yield/plant both at phenotypic and genotypic level. The line which is having higher seed weight will

be helping in improving seed yield/plant. The outcomes are in consonance with Ammara Fazal *et al.,* (2015) and Vina *et al.,* (2017).

There was positive significant correlation between branches per plant and seed yield/plant, more number of branches leads to more capsules per plant ultimately helps in improving yield/plant these results are in consonance with Vina *et al.,* (2017) and Yirga (2017). There was positive non-significant correlation between oil content and seed yield/plant the outcome were in consonance with Sumathi *et al.,* (2007) and Khairnar and Monpara (2013). There was negative non-significant correlation between days to 50 % flowering and days to maturity with seed yield/plant. The results are in consonance with Akbar *et al.,* (2011), Khairnar and Monpara (2013), Baraki *et al.,* (2015). On the other hand, Hika *et al.,* (2014), observed that there was significant positive correlation. Therefore, selecting tall plants with more number of capsules, longer capsule length, high number of branches and high 1000 seed weight will lead to increase in yield. In order to understand ideal plant type, it is also important to know significant inter-relationship between the traits. The information regarding the correlation among the yield contributing characters and magnitude of interrelationship with each other helpful in improvement of more than one character along with seed yield/plant.

The trait, days to 50 % flowering exhibited positive and significant association with days to maturity and height to first capsule, these outcomes in accordance with results of Sudhakar *et al.,* (2007), Parameshwarappa *et al.,* (2009), Sumathi and Muralidharan (2010), Ibrahim and Khidir (2012), Ammara Fazal *et al.,* (2015) and Baraki*et al.,* (2016) for days to maturity. Ibrahim and Khidir (2012) and Engin Yol *et al.,* (2010) for capsules per plant and for capsule length Sudhakar *et al.,* (2007). The character days to maturity has positive significant correlation with days to 50 % flowering and height to first capsule, the results are in accordance with Engin Yol *et al.,* (2010).

There was positive significant association between plant height and the traits such as height to first capsule, branches per plant, capsules/plant and oil content. This results are in consonance with results of Goudappagoudra *et al.,* (2011), Ibrahim and Khidir (2012) and Ammara Fazal *et al.,* (2015) for height to first capsule. Sudhakar (2007), Sumathi *et al.,* (2007), Parameshwarappa *et al.,* (2009a) and Engin Yol *et al.,* (2010) for the trait capsule/plant. Sudhakar *et al.,* (2007) and Parameshwarappa *et al.,* (2009a) for the trait capsule length and Engin Yol*et al.,* (2010) and Ammara Fazal *et al.,* (2015) for number of branches per plant and Atul Singh *et al.,* (2018) for oil content. There was a positive significant correlation between number of branches and traits like plant height, height to first capsule, number of capsules, 1000 seed weight and oil content the results are in consonance with Yirga (2017) and Atul Singh *et al.,* (2018).

There was highly significant positive correlation of number of capsules with traits such as plant height, height to first capsule, branches/plant, capsule length and 1000 seed weight, these results are in accordance with Solanki and Gupta (2003), for plant height, branches and number of capsules. Motilal and Manoharan (2006) for seeds per capsule and 1000 seed weight. Sumathi *et al.,* (2007) for all traits except 1000 seed weight. Atul Singh *et al.,* (2018) for oil content and plant height.

Capsule length had showed positive significant correlation with thousand seed weight and oil content, these results are in consonance with Sudhakar *et al.,* (2007), Vina *et al.,* (2017) and Atul Singh *et al.,* (2018).

Table.1 Genotypic correlation coefficients between seed yield and component traits in sesame

Sl. No.	Characters	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10
1	X1	**1.000**	0.873**	0.016	0.259**	-0.049	-0.014	-0.114	-0.013	-0.111	-0.076
2	X2		**1.000**	0.026	0.251**	-0.051	-0.013	-0.076	-0.011	-0.012	-0.067
3	X3			**1.000**	0.542**	0.817**	0.571**	0.005	0.458**	-0.010	-0.170*
4	X4				**1.000**	0.544**	0.189**	0.258**	0.141	-0.246**	0.301**
5	X5					**1.000**	0.651**	0.035	0.329**	0.165*	0.230**
6	X6						**1.000**	0.292**	0.678**	0.182*	0.032
7	X7							**1.000**	0.363**	0.514**	0.163*
8	X8								**1.000**	0.279**	0.107
9	X9									**1.000**	0.463**
10	X10										**1.000**

**, * - Significant at 1% and 5% level of probability

X1. Days to 50% flowering
X2. Days to maturity
X3. Plant height (cm)
X4. Height to first capsule (cm)
X5. Number of branches per plant
X6. Number of capsules per plant
X7. Capsule length (cm)
X8. Seed yield per plant (g)
X9. 1000 seed weight (g)
X10. Oil content (%)

Table.2 Phenotypic correlation coefficients between seed yield and component traits in sesame

Sl. No.	Characters	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10
1	X1	**1.000**	0.986**	-0.049	0.107	0.017	-0.031	-0.131	-0.225	-0.018	-0.039
2	X2		**1.000**	-0.042	0.107	0.007	-0.101	-0.052	-0.212	-0.032	-0.038
3	X3			**1.000**	0.499**	0.594**	0.513**	0.163*	0.367**	-0.036	-0.057
4	X4				**1.000**	0.368**	0.187**	-0.112	0.115	0.227**	-0.095
5	X5					**1.000**	0.526**	0.101	0.280**	0.134	-0.019
6	X6						**1.000**	0.228**	0.661**	0.145*	-0.044
7	X7							**1.000**	0.246*	0.275**	0.092
8	X8								**1.000**	0.246**	0.027
9	X9									**1.000**	0.161*
10	X10										**1.000**

**, * - Significant at 1% and 5% level of probability

X1. Days to 50% flowering
X2. Days to maturity
X3. Plant height (cm)
X4. Height to first capsule (cm)
X5. Number of branches per plant
X6. Number of capsules per plant
X7. Capsule length (cm)
X8. Seed yield per plant (g)
X9. 1000 seed weight (g)
X10. Oil content (%)

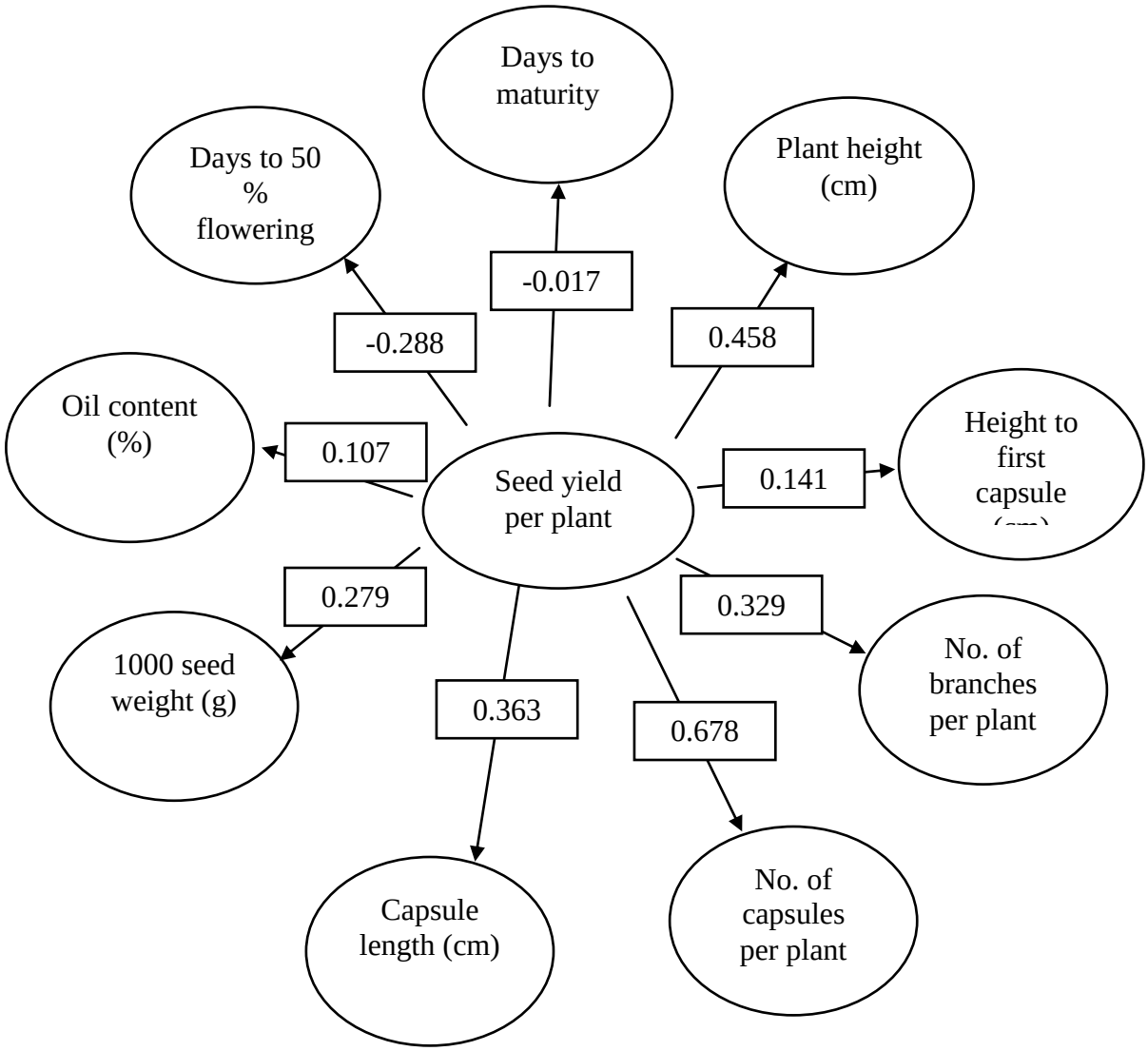
Table.3 Direct (diagonal) and indirect effects of characters on seed yield at genotypic level in sesame

Sl. No.	Characters	X1	X2	X3	X4	X5	X6	X7	X9	X10	Genotypic correlation with seed yield
1	X1	**-0.443**	0.446	-0.007	-0.114	0.021	0.102	0.050	0.147	0.033	-0.028
2	X2	0.182	**0.181**	0.004	0.045	-0.009	-0.039	-0.013	-0.052	-0.012	-0.017
3	X3	0.008	0.014	**0.548**	0.297	0.448	0.013	0.003	-0.005	-0.093	0.458**
4	X4	0.060	0.059	0.127	**0.234**	0.127	0.044	-0.060	-0.057	-0.070	0.141*
5	X5	0.035	0.036	0.581	-0.038	**-0.710**	0.463	-0.025	0.117	0.163	0.329**
6	X6	-0.114	-0.106	0.380	0.126	0.434	**0.666**	0.195	0.121	0.021	0.678**
7	X7	-0.033	-0.022	0.001	-0.076	0.010	0.086	**0.295**	0.151	0.048	0.363**
8	X9	0.063	0.055	0.002	0.046	0.0314	-0.03	-0.097	**-0.190**	-0.088	0.279**
9	X10	-0.008	-0.007	-0.017	-0.031	0.024	0.003	0.017	0.048	**0.104**	0.107

**, * - Significant at 1% and 5% level of probability, respectively

X1. Days to 50% flowering
X2. Days to maturity
X3. Plant height (cm)
X4. Height to first capsule (cm)
X5. Number of branches per plant
X6. Number of capsules per plant
X7. Capsule length (cm)
X9. 1000 seed weight (g)
X10. Oil content (%)

Fig.1 Genotypic path diagram for seed yield and component characters under study



$R^2 = 0.607$
Residual effect = 0.236

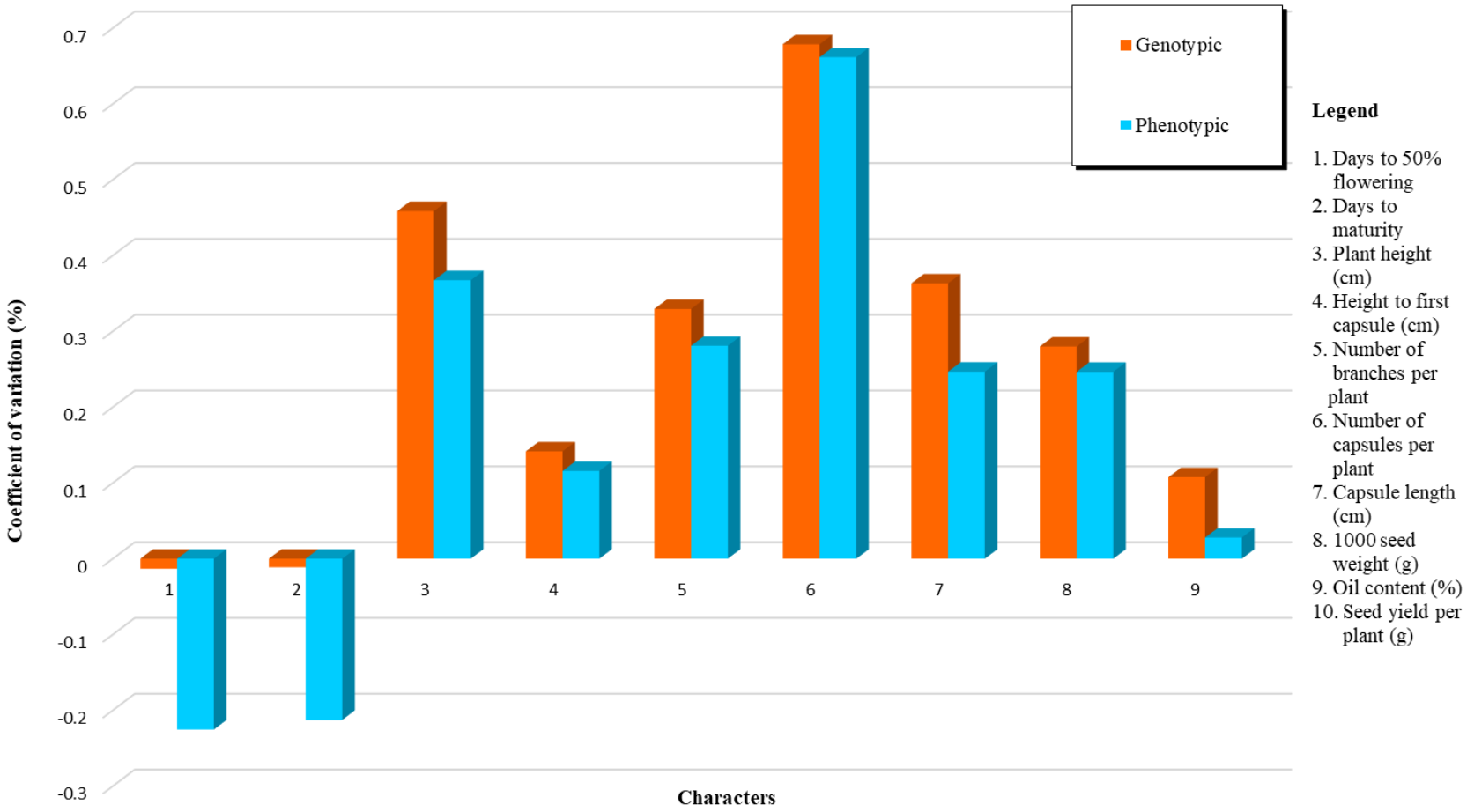


Fig. 2: Genotypic and phenotypic correlation coefficients of seed yield and component traits in sesame

However, in the present study the trait seed yield per plant had significantly associated with number of capsule, plant height, number of branches and also capsule length, so while practising selection those correlations have to be kept in mind. Correlation study helps us to know only the nature of association between the character and yield attributes, it does not depict direct and indirect effect. Therefore, by using path analysis, we can assess the direct and indirect effects.

In the current investigation path analysis computed at genotypic level (Table. 3). Among all the traits highest direct effect was shown by number of capsules/plant on seed yield, the results are in accordance with Sumathi *et al.,* (2007) and Ashok Shindhe (2009). If there are more number capsules per plant that will lead to increase in seed yield per plant. Plant height has negative direct effect on seed yield per plant it was also reported by Ammara Fazal *et al.,* (2015). Nevertheless, plant height had significant quantity of indirect effect through capsules per plant. So when direct selection for plant height will improve capsules/plant ultimately it improves seed yield per plant indirectly (Fig. 2).

Height to first capsule was having positive direct effect on seed yield per plant and had high indirect effect via number of branches per plant, the results are in consonance with Biabani and Pakniyat (2008), Ashok Shindhe (2009) and Allolli (2009). Branches/plant had negative direct effect and its indirect effect was positive through plant height was higher, the results are in agreement with Engin Yol *et al.,* (2010). There was positive direct effect between character capsule length on seed yield per plant and indirect effect was higher through 1000 seed weight, the results are in accordance with Sudhakar *et al.,* (2007). 1000 seed weight has negative direct effect on seed yield per plant, the outcomes are in consonance with Hika *et al.,* (2014). On the other side positive direct effect of 1000 seed weight with seed yield/plant was reported by Ibrahim and Khidir (2012). Most of the traits showed positive indirect effect on seed yield per plant but some of the traits such as capsule length in accordance with Biabani and Pakniyat (2008) and oil content showed negative indirect effect on seed yield per plant, this is in agreement with Siddique *et al.,* (2005).

From the present investigation it is found that capsule/plant, plant height, capsule length and plant height to first capsule was to given more importance during the selection because these characters showing high direct effect and higher correlation with character seed yield per plant and it has direct contribution towards yield per plant by number of capsules, hence these traits must be kept in mind while practising selection for improvement of seed yield.

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