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Correlation and Path analyses in Sesame (*Sesamum indicum* L.)

J V Ramana, V Satyanarayana Rao, Lal Ahamed M, Y Asoka Rani and P Anil Kumar
Department of Genetics and Plant Breeding, Agricultural College, Bapatla- 522101, Andhra Pradesh

ABSTRACT

The study was undertaken with an objective to study the correlation and path analysis for seed yield and yield traits in sesame during *rabi*, 2010 at Agricultural Research Station, Yelamanchili, Andhra Pradesh. The correlation analysis revealed that the genotypic correlations were, in general, higher than the phenotypic correlations and thus suggested that the observed relationships among the characters were due to genetic factors. The trait, seed yield per plant had highly significant positive association with capsules per plant, seeds per capsule and 1000 seed weight indicating the importance of these traits in improving the seed yield per plant while oil content was negatively associated with seed yield per plant indicating higher the yield lesser will be the oil content. Path analysis revealed that primary branches per plant, capsules per plant, seeds per capsule and 1000-seed weight had true relationship by establishing significant positive association and positive direct effect on seed yield per plant. Considering the nature and magnitude of character association and their direct and indirect effects, it can be inferred that simultaneous improvement of seed yield per plant is possible through manifestation of primary branches per plant, capsules per plant, seeds per capsule and 1000-seed weight.

Key words : Correlation, Path analysis, Seed yield and Sesame.

Sesame is known as "Queen of oil seeds" and oil quality of sesame is excellent with 50-53% of oil and 20-26% of protein content. Sesame is highly nutritive and has medicinal value and its oil contains an antioxidant called sesamol which imparts a high degree of resistance against oxidative rancidity along with vitamin E and essential amino acid, methionine. It is considered to be the oldest of the oil seed crops which are under cultivation in Asia from ancient times. Sesame is one of the most important oil seed crops grown in the tropics as well as temperate zones mostly between altitudes of 40^0N and 40^0S. In India, it is important next to groundnut, rapeseed and mustard. India, China, Sudan and Burma are the major sesame producing countries that contribute to about 60 per cent of the total world production.

In India, the sesame oil and yield productivity are static over years and not impressive as compared to the other sesame growing countries of the world. The slow improvement in sesame is due to the arbitrary choice of parents and inadequate information about the nature of gene action in governing the traits. Yield is a complex and polygenically inherited character resulting from multiplicative interaction of its component traits. The cumulative effect of such traits determines the yield. These traits play an important role in modification of yield as a whole in magnitude as well as in direction. The change in one character brings about a series of changes in the other characters, since they are interrelated. Therefore, the correlation and path analysis studies are of considerable importance in any selection programme as they provide degree and direction of relationship between two or more component traits. Keeping this in view, the present experiment was conducted to study the correlation and path analysis among the yield and yield components in sesame.

MATERIAL AND METHODS

The present investigation was executed with 36 genotypes of sesame and evaluated for yield and yield components *viz.,* days to 50% flowering, days to maturity, plant height, primary branches/plant, capsules per plant, number of seeds per capsule, 1000 seed weight, oil content and seed yield per plant during *rabi* 2010 in randomized block design with three replications at Agricultural Research Station, Yelamanchili, Andhra Pradesh. The intra and inter row spacing was 10 cm x 20 cm, with 4 rows per genotypes per replication. Recommended package of practices were followed to raise a good crop. The mean values were used for the statistical analysis. The data was analysed statistically to compute the correlations (Falconer, 1964) and path effects (Dewey and Lu, 1959).

RESULTS AND DISCUSSION

The phenotypic and genotypic correlation coefficients between seed yield and yield component characters and among themselves were estimated and presented in the Table 1. The results were discussed character wise hereunder. Genotypic correlations in general are higher than phenotypic correlations. This may be due to the relative stability of genotypes as majority of them were already subjected to certain amount of selection.

Days to 50% Flowering

At phenotypic level this character showed significant negative association with primary branches per plant (-0.19*), 1000 seed weight (-0.20*), plant height (-0.23*) and seed yield per plant (-0.23*) indicating the importance of days to 50% flowering in deciding the seed yield *i.e.,* more days to 50% flowering reduces seed yield per plant. The above results are in accordance with the findings of Solanki and Deepak Gupta (2001).

Days to Maturity

This character showed non-significant positive association with seed yield per plant (0.01) while oil content (-0.05), 1000 seed weight (-0.15) and plant height (-0.01) had non significant negative association with this trait at phenotypic level indicating more number of days to maturity reduces the oil content and 1000 seed weight. These results are in conformity with the findings of Renuka *et al.* (2011).

Plant Height

This character had non-significant positive association with seed yield per plant (0.04). The characters primary branches per plant (0.20*) showed significant positive association with this trait indicating more number of primary branches with increased plant height. Similar association was also reported by Kumaresan and Nadarajan (2002) and On'gsinjo and Ayiecho (2009).

Primary Branches per Plant

This trait had non-significant positive association with seed yield per plant (0.19) while capsule per plant (0.66**) had highly significant positive association with thin trait indicating more number of capsules with increased number of primary branches. The trait 1000 seed weight (-0.26**) had highly significant negative association with primary branches per plant indicating lower 1000 seed weight with increased number of primary branches. These findings are in accordance with the results of Solanki and Deepak Gupta (2001b).

Capsules per Plant

This trait recorded highly significant positive association with seed yield per plant (0.57**) and significant association with seeds per capsule (0.19*). The character oil content (-0.28**) showed highly significant negative association with this trait indicating increased capsules per plant will lead to lower oil content. Similar associations were reported Swapna *et al.* (2009) and Yol *et al.* (2010).

Seeds per capsule

The seed yield per plant had highly significant positive association (0.50**) with this trait indicating more number of seeds per capsule will lead to higher seed yield per plant. Similar results were also reported by Azeez and Morakinyo (2011), Renuka *et al.* (2011) and Vanishree *et al.* (2011).

1000 Seed Weight

This trait showed highly significant positive association with seed yield per plant (0.65**) indicating more seed weight leading to more yield. These results are in accordance with the findings of Sumathi and Muralidharan (2010), Yol *et al.* (2010), Azeez and Morakinyo (2011) and Renuka *et al.* (2011).

Oil Content

The trait, oil content was negatively associated with seed yield per plant (-0.13) indicating higher the yield lesser will be the oil content. Similar associations were reported by Vadhavani *et al.* (1992).

The seed yield per plant had highly significant positive association with capsules per

Table 1. Phenotypic (r_p) (above diagonal) and Genotypic (r_g) (below diagonal) correlation coefficients for different traits in sesame.

Character	Days to 50% flowering	Days to maturity	Plant height cm	Primary branches/ plant	Capsules/ plant	Seeds/ capsule	1000 seed weight	Oil content	Seed yield/ plant
Days to 50% flowering	**1.0000**	0.0147	-0.2322*	-0.1975*	-0.1216	-0.0774	-0.2003*	0.0590	**-0.2377**
Days to maturity	0.4851	**1.0000**	-0.0105	0.1531	0.1243	0.0423	-0.1556	-0.0503	**0.0193**
Plant height cm	-0.4505	0.3723	**1.0000**	0.2001*	0.1304	0.0530	-0.0323	0.0508	**0.0436**
Primary branches/ plant	-0.3202	0.2580	0.2554	**1.0000**	0.6671**	0.0273	-0.2608**	-0.0882	**0.1986**
Capsules/ plant	-0.4379	0.2483	0.1964	0.8261	**1.0000**	0.1996*	-0.0555	-0.2806**	**0.5796**
Seeds/ capsule	-0.1830	0.1197	0.2654	0.0626	0.3255	**1.0000**	-0.0055	-0.0065	**0.5022**
1000 seed weight	-0.2953	-0.4885	-0.0292	-0.2995	-0.0785	-0.0110	**1.0000**	0.0052	**0.6578**
Oil content	0.0727	-0.1918	0.1215	-0.0904	-0.3448	-0.0324	-0.0175	**1.0000**	**-0.1337**
Seed yield/ plant	**-0.5055**	**-0.2014**	**0.1582**	**0.2361**	**0.5774**	**0.5221**	**0.6895**	**-0.1904**	**1.0000**

*, **= significant at 5% and 1%, respectively

Table 2. Direct and indirect effects for different characters in sesame.

Character		Days to 50% flowering	Days to maturity	Plant height cm	Primary branches/ plant	Capsules/ plant	Seeds/ capsule	1000 seed weight	Oil content
Days to 50% flowering	P	-0.0082	-0.0001	0.0019	0.0016	0.0010	0.0006	0.0016	-0.0005
	G	-0.0097	-0.0047	0.0044	0.0031	0.0042	0.0018	0.0029	-0.0007
Days to maturity	P	0.0000	**0.0031**	0.0000	0.0005	0.0004	0.0001	-0.0005	-0.0002
	G	0.0020	**0.0041**	0.0015	0.0011	0.0010	0.0005	-0.0020	-0.0008
Plant height cm	P	0.0073	0.0003	**-0.0312**	-0.0062	-0.0041	-0.0017	0.0010	-0.0016
	G	0.0146	-0.0120	**-0.0324**	-0.0083	-0.0064	-0.0086	0.0009	-0.0039
Primary branches/ plant	P	-0.0034	0.0027	0.0035	**0.0174**	0.0116	0.0005	-0.0045	-0.0015
	G	-0.0114	0.0092	0.0091	**0.0357**	0.0295	0.0022	-0.0107	-0.0032
Capsules/ plant	P	-0.0650	0.0664	0.0697	0.3566	**0.5346**	0.1067	-0.0297	-0.1500
	G	-0.2142	0.1214	0.0961	0.4040	**0.4891**	0.1592	-0.0384	-0.1686
Seeds/ capsule	P	-0.0309	0.0169	0.0212	0.0109	0.0798	**0.3998**	-0.0022	-0.0026
	G	-0.0687	0.0449	0.0997	0.0235	0.1222	**0.3756**	-0.0041	-0.0122
1000 seed weight	P	-0.1386	-0.1076	-0.0223	-0.1805	-0.0384	-0.0038	**0.6919**	0.0036
	G	-0.2189	-0.3620	-0.0216	-0.2220	-0.0582	-0.0082	**0.7411**	-0.0129
Oil content	P	0.0011	-0.0010	0.0010	-0.0017	-0.0054	-0.0001	0.0001	**0.0191**
	G	0.0009	-0.0023	0.0015	-0.0011	-0.0041	-0.0004	-0.0002	**0.0120**
Seed yield/ plant	P	-0.2377*	-0.0193	0.0436	0.1986	0.5796**	0.5022**	0.6578**	-0.1337
	G	-0.5055	-0.2014	0.1582	0.2361	0.5774	0.5221	0.6895	-0.1904

P = Phenotypic level and G = Genotypic level

Genotypic residual effect = 0.0738; Phenotypic residual effect = 0.1813

Diagonal values in bold represent the direct effects.

plant, seeds per capsule and 1000 seed weight indicating the importance of these traits in improving the seed yield per plant.

PATH COEFFFICIENT ANALYSIS

Yield being a complex character, is composed of several components some of which affect yield directly while others contribute towards it indirectly. Correlation studies provide an opportunity to study the magnitude and direction of association of yield with its components and also among various components. To accumulate optimum combination of yield contributing characters in a single genotype, it is essential to know the amplification of interrelationship of various characters with standard partial correlation or regression.

In the present study, path analysis was used to work out the direct and indirect effects of yield contributing characters on yield and the results are presented (Table. 2) character wise hereunder. The phenotypic values in general are higher over genotypic values indicating the influence of environment in the expression of the traits.

Days to 50% flowering

At phenotypic level days to 50% flowering exhibited significant negative correlation (-0.23*) and negative direct effect (-0.0082) on seed yield per plant. This trait also exhibited positive indirect effects *via* plant height (0.0019), primary branches per plant (0.0016), capsules per plant (0.0010), seeds per capsule (0.0006) and 1000 seed weight (0.0016) while it showed negative indirect effects through oil content (-0.0005) and days to maturity (-0.0001). These results were in accordance with Vidhyhavathi *et al.* (2005a), Gangadhararao (2007) and Yol *et al*. (2010). As the correlation coefficient and direct effect of this trait are negative indicating the importance of this trait in selecting genotypes with earliness.

Days to maturity

This trait showed non-significant negative association (-0.0193) and positive direct effect (-0.0031) on seed yield per plant. It also displayed positive indirect effects through primary branches per plant (0.0005), capsules per plant (0.0004) and seeds per capsule (0.0001) while negative indirect effects through 1000 seed weight (-0.0005) and oil content (-0.0002). Thus, days to maturity showed negative correlation and positive direct effect on seed yield per plant indicating the importance of this trait in selection programmes. Similar results were also reported by Sumathi and Muralidharan (2010), Renuka *et al.* (2011) and Vanishree *et al.* (2011).

Plant height

This trait had non-significant positive correlation (0.0436) and negative direct effect on seed yield per plant (-0.0312) at phenotypic level. It also expressed negative indirect effects through primary branches per plant (-0.0062), capsules per plant (-0.0041), seeds per capsule (-0.0017) and oil content (-0.0016) while positive indirect effects *via* days to 50% flowering (0.0073), 1000 seed weight (0.0010) and days to maturity (0.0003). Thus, the trait, plant height, showed negative direct effect and positive correlation with seed yield per plant. Similar result with respect to negative direct effect was in agreement with the results of Gangadhara Rao (2007). This situation indicated the contribution of indirect effects particularly towards the selection of medium plant height genotypes with earliness.

Number of primary branches per plant

This character expressed non-significant positive association (0.1986) and positive direct effect (0.0174) on seed yield per plant at phenotypic level. This trait also showed positive indirect effects *via* days to maturity (0.0027), plant height (0.0035), capsules per plant (0.0116) and seeds per capsule (0.0005) while negative indirect effects through days to 50% flowering (-0.0034), 1000 seed weight (-0.0045) and oil content (-0.0015) on seed yield per plant. Similar results were reported by Muhamman *et al.* (2010). This situation indicated the contribution of indirect effects particularly capsules per plant for improving the seed yield per plant. Therefore, this trait has to be considered simultaneously during selection programme for the improvement of seed yield per plant.

Number of capsules per plant

At phenotypic level, number of capsules per plant exhibited highly significant positive association (0.5796**) and positive direct effect (0.5346) on seed yield per plant. It also showed positive indirect effects *via* days to maturity (0.0664), plant height (0.0697), primary branches per plant (0.3566) and seeds per capsule (0.1067). Whereas it recorded negative indirect effects through days to 50% flowering (0.0650), 1000 seed weight (-0.0297) and oil content (-0.1500). Thus, this trait exhibited positive direct effect coupled with highly significant positive correlation indicating the true relationship and direct selection through this trait will be effective for seed yield per plant improvement. These results were in conformity with the findings of Yole *et al*. (2010), Renuka *et al.* (2011) and Vanishree *et al*. (2011).

Number of seeds per capsule

This trait exhibited highly significant positive correlation (0.5022**) and positive direct effect (0.3988) on seed yield per plant at phenotypic level. It also showed positive indirect effects through days to maturity (0.0169), plant height (0.0212), primary branches per plant (0.0109) and capsules per plant (0.0798) whereas negative indirect effects were recorded *via* 1000 seed weight (-0.0022), oil content (-0.0026) and plant height (-0.0309). Thus, the trait, number of seeds per capsule, had positive direct effect coupled with highly significant positive association with seed yield per plant indicating direct selection through this trait will be effective for seed yield improvement. Similar results were reported by Morakinyo (2011), Renuka *et al.* (2011) and Vanishree *et al*. (2011).

1000 seed weight

At phenotypic level 1000 seed weight had highly significant positive association (0.6578) and positive direct effect (0.6919) on seed yield per plant. It also showed negative indirect effects through days to 50% flowering (-0.1386) days to maturity (-0.1076), plant height (-0.0223), primary branches per plant (-0.1805), capsules per plant (-0.0384) and seeds per capsule (-0.0038). Thus, this trait had positive direct effect and highly significant positive association with seed yield per plant indicating the importance of direct selection for seed yield improvement through this trait. These results are in agreement with the results of Yol *et al*. (2010), Azeez and Morakinyo (2011), Renuka *et al*. (2011) and Vanishree *et al*. (2011).

Oil content

Direct effect of this trait on seed yield per plant was positive (0.0191) and showed non-significant negative association (-0.1337) with seed yield per plant. It also showed positive indirect effects *via* days to 50% flowering (0.0011), plant height (0.0010) and 1000 seed weight (0.0001) and negative indirect effects *via* days to maturity (-0.0010), primary branches per plant (-0.0017), capsules per plant (0.0054) and seeds per capsule (-0.0001).

Thus, oil content showed positive direct effect and non-significant negative association. These results are in accordance with Gangadhararao (2007) and Sumathi and Muralidharan (2010).

Considering the nature and magnitude of character association and their direct and indirect effects, it can be inferred that simultaneous improvement of seed yield per plant is possible through manifestation of primary branches per plant, capsules per plant, seeds per capsule and 1000-seed weight.

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