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Association Analysis of Yield and Its Component Traits in Sesame (*Sesamum indicum* L.)

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A B S T R A C T

Twenty-four genotypes of Sesame (*Sesamum indicum* L.) were evaluated in Randomized Block Design with three replications during *kharif* season of2016 to study character association for seed yield and its component characters. There was positive, significant and strong correlation of seed yield per plant with number of branches per plant (rg=0.616 and rp=0.410), number of capsules per plant (rg=0.821 and rp=0.480), number of seeds per capsules (rg=0.690 and rp=0.449), 1000-seeds weight (rg = 0.493 and rp = 0.368), biological yield per plant (rg = 0.267 and rp = 0.274) and harvest index (rg = 0.682 and rp = 0.696). While, it was negatively and significantly correlated with days to 50% flowering (rg= -0.384) and plant height (rg= -0.357 and rp= -0.278). According to path analysis, harvest index (1.086) and biological yield per plant (0.847) have positive and high direct effects with seed yield per plant, indicating importance of these characters and can be strategically used to improve the seed yield of sesame through indirect selection using these component traits.

Introduction

Malnutrition and under-nutrition are serious problems in the developing countries of the world. As majority of population is vegetarian, the availability of good quality nutrition is reduced. Oilseeds are next to cereals in importance and more energetic providing superior quality protein, essential fatty acids, vitamins and minerals (Jain *et al.*, 2015). In India, nine major oilseeds i.e. groundnut, rapeseed-mustard, soybean, sunflower, sesame, safflower, niger, castor and linseed are produced. Among them, sesame (*Sesamum indicum* L.) is very important oilseed crop and popularly known as 'Queen of Oilseeds' due to its high degree of resistance to oxidation and rancidity (Yadava *et al.*, 2012). Sesame seed has a high food value because of its higher contents of good quality edible oil and nutritious protein. Annual production of Sesame during 2015-16 in India was 8,50,000 tones with productivity of 436 kg/hectare and total area under cultivation was 19,51,000 hectares with West Bengal being the leading producer followed by Madhya Pradesh, Rajasthan and Uttar Pradesh. Annual global production of Sesame is 6.9 million tones, with United Republic of Tanzania being the top producer followed by India (Anonymous, 2016). As we know, sesame crop comes under orphan crops. Orphan crops are considered as the major staple food crops in many developing countries because of their particular role in food security, nutrition, and income generation to poor farmers and consumers. Orphan crops are in general more adapted to the extreme soil and climatic conditions prevalent in India than the world's major crops like Wheat and Rice. Due to lack of efficient crop improvement programmes, orphan crops produce inferior yield in terms of both quality and quantity (Tadele, 2019). Looking to the average productivity, it is quite clear that still there is a considerable scope for increasing yield potential of Sesame crop through the genetic improvement. To accomplish success in sesame improvement programme, it requires studying the character association like correlation and path analysis among yield and its component traits.

Correlation coefficient is a statistical measure which is used to find out the degree of relationship between two or more variable and it is represented by r. In crop breeding, correlation coefficient measures the mutual relationship between various traits and determines the component character on which selection can be relied upon for genetic improvement of yield potential of crop plants (Kumar and Paul, 2016). However, correlation coefficient measures only the degree and direction of association between two traits. The estimates of correlations alone may also be misleading due to mutual cancellation of component traits. When the indirect associations become complex, path coefficient analysis is the most effective technique to find out direct and indirect causes of association among the different variables because it measures the cause of association between two characters. So, it becomes necessary to study path coefficient analysis, which takes into account the casual relationship in addition to degree of relationship (Bhargava *et al.,* 2019). In such case, path coefficient analysis is an important technique for partitioning the correlation coefficient into direct and indirect effect of independent variables on dependent variable. Even, it also estimates the residual effects. Sasipriya *et al.*, (2018) concluded that even if correlation coefficient values are similar for certain pairs of traits, direct effects for some of them and especially indirect effects via other traits can differ for some traits. It is therefore, correlation as well as path coefficient may be important tools for the breeder to enhancing the seed yield of sesame. Keeping the above facts in view, the present investigation aimed to assess the degree of relationship and to determine the direct and indirect influences of yield and its attributing characters in sesame.

Materials and Methods

The present field experiment was conducted at Research farm of DLA unit, Department of Agronomy, College of Agriculture, CCS Haryana Agricultural University, Hisar (Haryana) during *kharif* season of the year 2016, under rainfed condition with no pre and post sowing irrigation. The experimental material for present study consisted of 24sesame genotypes, which were received from Oilseeds section, Department of Genetics and Plant Breeding, CCS Haryana Agricultural University, Hisar (Haryana). Experiment was laid out in randomized complete block design with three replications. Each genotype was sown on 11-7-2016 in five rows of 4 meters length spaced at 45 cm and plant to plant distance was 10 cm. All the recommended package of practices (for rainfed agriculture) were adopted to raise a good crop. The observations on the traits; days to flowering (50%) and days to maturity were recorded on plot basis for while rest of the traits were on the basis of five randomly selected competitive plants from each genotype and in each replication and averaged. The mean values over replications were used for statistical analysis of data.

The correlation coefficients among all possible character combinations at phenotypic and genotypic level were estimated by employing the formulae given by Al-Jibouri *et al.,* (1958). Path coefficient analysis was done as per the formula given by Wright (1921) and adopted by Dewey and Lu (1959). Genotypic correlation coefficients of nine morphological characters with seed yield per plant were used to estimate the path coefficients for the direct and indirect effects of various independent characters on yield. The statistical analysis of data was done with SPSS Version 11.0 statistic software package.

Results and Discussion

Magnitudes of genotypic correlation coefficients for all the characters were higher than their corresponding phenotypic correlation coefficients, which indicated the presence of inherent or genetic association among various characters. Therefore, selection on the basis of the phenotype would be effective. Similar observations in sesame were made by Sumathi *et al.,* (2007) and Hika *et al.,* (2014). Correlation coefficients (Table 1) were estimated between seed yield per plant and other traits under study revealed that seed yield per plant showed significant and positive correlation with number of branches per plant (rg=0.616 and rp=0.410); number of capsules per plant (rg = 0.821 and rp = 0.480); number of seeds per capsule (rg = 0.690 and rp = 0.449); 1000-seeds weight (rg = 0.493 and rp = 0.368); biological yield per plant (rg = 0.267and rp = 0.274) and harvest index (rg = 0.682 and rp = 0.696) at both the genotypic and phenotypic levels. Hence, these characters should be given priority while selecting for increasing seed yield of sesame. While, seed yield per plant was negatively and significantly correlated with days to 50% flowering (rg=-0.384) at genotypic level and plant height (rg= -0.357 and rp=-0.278) at both genotypic and phenotypic levels respectively. Out of these characters, days to 50% flowering was significantly and positively correlated with days to maturity (rg=0.970 and rp=0.750) at both genotypic and phenotypic level and with 1000-seed weight (0.378) at genotypic level only. But, it had significant and negative genotypic correlation with harvest index (-0.267); plant height (-0.337) and number of capsules per plant (-0.509),while Plant height exhibited significant and negative correlation with 1000-seed weight (- 0.639 and -0.454); seed yield per plant (-0.357 and -0.278); harvest index (-0.263 and -0.241) at both genotypic and phenotypic level; and with number of branches per plant (rg = -0.255); number of capsules per plant (rg = -0.233) at genotypic level only. Days to maturity showed no significant association with seed yield per plant. Positive and significant correlation of seed yield per plant with number of branches per plant, number of capsules per plant, number of seeds per capsule, 1000-seed weight, biological yield per plant and harvest index indicating their importance in increasing yield. Similar results for one or more of these characters were also reported by earlier studies of many researchers like Khairnar and Monpara (2013), Hika *et al.,* (2014), Ismaila and Usman (2014), Abate *et al.,* (2015), Mustafa *et al.,* (2015), Meenakumari and Ganesamurthy (2015), Bamrotiya *et al.,* (2016), Saxena and Bisen (2016), Lal *et al.,* (2016), Abhijatha *et al.,* (2017) and Ozcinar and Sogut (2017).

Table.1 Phenotypic (above diagonal) and genotypic (below diagonal) correlation coefficients among morphological characters in sesame

Traits	DF	DM	PH	NBP	NCP	NSC	1000 SW	BYP	HI	SYP
DF	1.000	0.750**	-0.183	0.058	0.017	-0.166	0.206	-0.017	0.051	0.019
DM	0.970**	1.000	-0.178	-0.011	-0.055	-0.111	0.111	0.080	-0.136	-0.102
PH	-0.337**	-0.213	1.000	-0.124	-0.098	-0.027	-0.454**	0.019	-0.241*	-0.278*
NBP	0.078	-0.136	-0.255*	1.000	0.322**	0.119	0.201	0.359**	0.177	0.410**
NCP	-0.509**	-0.232*	-0.233*	0.552**	1.000	0.160	-0.182	0.199	0.314**	0.480**
NSC	-0.203	-0.164	-0.079	0.224	0.266*	1.000	0.148	0.027	0.366**	0.449**
1000 SW	0.378**	0.310**	-0.639**	0.356**	-0.196	0.183	1.000	0.152	0.253*	0.368**
BYP	-0.156	0.099	-0.015	0.539**	0.229	0.008	0.164	1.000	-0.447**	0.274*
HI	-0.267*	-0.324**	-0.263*	0.156	0.545**	0.589**	0.345**	-0.499**	1.000	0.696**
SYP	-0.384**	-0.217	-0.357**	0.616**	0.821**	0.690**	0.493**	0.267*	0.682**	1.000

***** Significant at 5% level;****** Significant at 1%level. [DF: Days to flowering; DM: Days to maturity; PH: Plant height (cm); NBP: No. of branches per plant; NCP: No. of capsules per plant; NSC: No. of seeds per capsule; 1000SW: 1000 Seeds weight (g); BYP: Biological yield per plant (g); HI: Harvest index (%); SYP: Seed yield per plant (g)]

Table.2 Path coefficient analysis for morphological characters in sesame for seed yield

Traits	DF	DM	PH	NBP	NCP	NSC	1000 SW	BYP	HI
DF	**0.068**	0.072	-0.023	0.005	-0.035	-0.014	0.026	-0.011	-0.018
DM	0.005	**0.005**	-0.001	-0.001	-0.001	-0.001	0.001	0.000	-0.002
PH	0.035	0.022	**-0.104**	0.027	0.024	0.008	0.066	0.002	0.027
NBP	-0.002	0.004	0.007	**-0.029**	-0.016	-0.007	-0.010	-0.016	-0.005
NCP	-0.011	-0.005	-0.005	0.012	**0.022**	0.006	-0.004	0.005	0.012
NSC	-0.014	-0.012	-0.006	0.016	0.019	**0.071**	0.013	0.001	0.042
1000 SW	-0.043	-0.035	0.072	-0.040	0.022	-0.021	**-0.113**	-0.018	-0.039
BYP	-0.132	0.084	-0.013	0.457	0.194	0.007	0.139	**0.847**	-0.423
HI	-0.290	-0.352	-0.285	0.170	0.593	0.640	0.374	-0.542	**1.086**
Genotypic correlation with SYP	-0.384**	-0.217	-0.357**	0.616**	0.821**	0.690**	0.493**	0.267*	0.682**

Residual effect: 0.03004

* Significant at 5 % level;** Significant at 1 %level. [DF: Days to flowering; DM: Days to maturity; PH: Plant height (cm); NBP: No. of branches per plant; NCP: No. of capsules per plant; NSC: No. of seeds per capsule; 1000SW: 1000 Seeds weight (g); BYP: Biological yield per plant (g); HI: Harvest index (%); SYP: Seed yield per plant (g)]

Selection would be helpful in simultaneous improvement in these traits for yield improvement of Sesame. Remaining characters with non-significant correlation could be improved independently without affecting others.

In this study, path coefficient was computed for seed yield per plant taking remaining 9 independent characters. The residual effect (R=0.03004) indicating that the component characters under study were responsible for about 97% of variability in seed yield per plant. Path coefficient analysis (Table 2) revealed that harvest index (0.1.086) and biological yield per plant (0.847) showed positive direct effect and significant association with seed yield per plant. The direct effect of number of seeds per capsules (0.071), number of capsules per plant (0.022) was low but its association with seed yield was positive because of positive and high indirect effect through harvest index (0.640 and 0.593, respectively). The direct effect of number of branches per plant (-0.029) was also low in magnitude and negative in direction, but their indirect effects through biological yield per plant (0.457) were high in magnitude and positive in direction. Similarly, the direct effects of 1000-seeds weight (-0.113) were negative but its indirect effect through harvest index (0.374) was high. Plant height contributed negative correlation with seed yield per plant and its direct effect (-0.104) on seed yield per plant was also negative. While days to flowering (50%) showed negative and significant association with seed yield per plant but its direct effect (0.068) on seed yield per plant was positive. The similar results for one or more characters were also obtained by Tomar *et al.,* (1999), Shi *et al.,* (2001), Sumathi *et al.,* (2007), Sumathi and Muralidharan (2010), Gnanasekaran *et al.,* (2008), Yol *et al.,* (2010), Vanishree *et al.,* (2011), Khairnar and Monpara (2013), Abate *et al.,* (2015), Mustafa *et al.,* (2015), Saxena and Bisen (2016), Bamrotiya *et al.,* (2016), Lal *et al.,* (2016) and Abhijatha *et al.,* (2017).

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