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Association Study and Path Analysis for Yield and its component traits in Sesame (*Sesamum indicum* L.)

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ABSTARCT: Direct selection for yield will not be the best strategy for an effective crop improvement programme. So selection of traits which are highly positively correlated with yield and have direct effects on seed yield will be the most effective method for improvement of yield and its component traits simultaneously. In the present investigationyield/plant had significant and positive association with the characters *viz.* number of capsules/plant, number of seeds/capsule, 1000-seed weight, capsule length and plant height where as it had no significant negative association with any character. Number of capsules/plant had the highest significant direct positive effect on seed yield/plant followed by number of seeds/capsule and 1000-seed weight. The highest significant positive indirect effect on seed yield was observed by 1000-seed weight *via* number of capsules/plant followed by number of seeds/capsule via capsules/plant.

Keywords: Association, Direct effect, significant, indirect effect.

INTRODUCTION

Sesame is known as queen of oil seed crop as it contains around 40-60 per cent oil of excellent quality with prominency of unsaturated fatty acids (Kamal-Eldin *et al*., 1992). For its stability against oxidative rancidity, the sesame oil is useful in cooking, confectionary purposes. It is also useful in making soaps, paints, manufacture of pharmaceuticals, and insecticides. Presence of sesamolin, sesamol, sesamin and γ-tocopherol in sesame oil increases its self life and makes it resistant against oxidative deterioration as compared to other edible oils (Fukuda *et al.*, 1986). Because of its wider adaptability sesame is grown throughout the tropical and sub-tropical regions of world and accounts for around 2.7% of global production (Thapa *et al*., 2019). It occupies the fifth position in India in terms of production after soybean, groundnut, sunflower and mustard amongst the minor oilseed crops (Pathak *et al.*, 2014). Worldwide, in terms of area it occupies 117 lakh ha with production of 60.16 lakh MT and productivity 512 kg/ha (Myint *et al.*, 2020). In India, it occupies an area of 17.30 lakh ha with the production of 7.46 lakh MT and productivity of 413 kg/ha (FAOSTAT, 2020). In India, Gujarat ranks first in sesame production accounting 22.3% of total production, followed by West Bengal (19.2%), Karnataka (13.5%), Rajasthan (9.8%), Madhya Pradesh (9.06%), Tamil Nadu (4.7%), Andhra Pradesh (4.52%) and Maharashtra (4.52%) (Directorate of Economics and Statistics, Department of Agriculture and Cooperation, 2019). In Odisha, it is cultivated in all thirty districts but extensively in Angul, Malkangiri, Sundargarh, Sambalpur, Dhenkanal and Bolangir districts of Odisha. The total area in Odisha is confined to 203.72 thousand ha with the production of 81.26 thousand MT and productivity of 392 kg/ha. (Odisha Agricultural Statistics, 2017-18). Despite of having wider adaptability, excellent oil quality and so many health benefits, the productivity of sesame in Odisha is less than the national as well as world average. The low productivity of sesame in Odisha is mainly due to lack of availability of high yielding genotypes and fluctuating yield performance of the sesame genotypes for their high genotype-environment interactions. Keeping all the constraints into consideration it is now a matter of utmost importance to augment the yield potential of sesame through development of hybrids or high yielding genotypes by genetic manipulation through crop improvement programme. Efficiency of selection plays a key role in crop improvement programme. Path analysis partitions the total correlation into direct and indirect effect which helps in identifying which trait is to be more prioritized during the selection process. Prior knowledge of correlation between yield and its component traits and path analysis study provide a scope to formulate an effective selection strategy for successful crop improvement programme. The analysis of correlation and path analysis both at phenotypic and genotypic level help in predicting the role of environment in expression of those characters.

Seed yield per plant was significantly positively correlated with plant height, branches per plant, capsule per plant, biomass yield and harvest index (Takele *et al.*, 2021). There may be some variation depending upon the sets of germplasms used. Hence, the present study was initiated to determine the associations between seed yield and related traits in sesame in nineteen genotypes of Sesame.

MATERIALS AND METHODS

Nineteen genotypes collected from different parts of India were evaluated in RBD design with three replications. The observations were recorded for eight morphological traits *viz.* days to 50 % flowering, plant height, number of branches/plant, capsule length, number of capsules/plant, number of seeds/capsule, 1000- seed weight and seed yield/plant. Correlation and path analysis were done using the method given by Wright, 1921; Dewey and Lu l959.

RESULTS AND DISCUSSION

A. Character association

The phenotypic and genotypic correlation coefficients were estimated among all pairs of eight quantitative characters which are presented in (Table 1). In the present investigation the genotypic correlation coefficient is higher than the phenotypic correlation coefficient indicating less effect of environment in expression of the studied characters.

The phenotypic correlation (rp) among eight characters ranged from -0.534 between days to 50% flowering and number of branches/plant to 0.944, between seed yield/plant and number of capsules/plant. The genotypic correlation (rg) ranged from -0.277 between days to 50% flowering and seed yield/plant to 0.918 between number of capsules/plant and seed yield/plant. Days to 50% flowering exhibited significant negative correlation with branches/plant (rp = -0.534, rg = -0.690) and plant height (rg = -0390). It expressed significant positive correlation with number of capsules/plant (r_g = 0.427) at genotypic level.

The most important yield attributing trait like number of capsules/plant was significantly positively correlated with days to 50% flowering (0.437), plant height (0.390) and number of branches/plant (0.432). Capsule length was positively associated with number of capsules/plant both phenotypically and genotypically (r_p=0.465, r_g = 0.581). Number of seeds/capsule is significantly positively correlated with capsule length (0.480, 0.627) and number of capsules/plant (0.581, 0.842) respectively both at phenotypic and genotypic level. Thousand seed weight showed significant positive correlation with capsule length (0.563, 0.743), number of capsules/plant (0.839, 0.827) and number of seeds/capsule (0.726, 0.965) both at phenotypic and genotypic level respectively.

Seed yield/ plant was positively associated with number of capsules/plant (0.944, 0.974), 1000-seed weight (0.925, 0.931), number of seeds/capsule (0.776, 0.918), capsule length (0.551, 0.676), plant height (0.370, 0.390) both at phenotypic and genotypic level respectively.

Table 1: Phenotypic (in bold) and genotypic correlation for yield and yield contributing traits in Sesame.

Characters	Days to 50% flowering	Plant height	Number of primary branches/plant	Capsule Length	Number of capsules /plant	Number of seeds /capsule	1000-Seed weight
Plant height	**0.291** -0.390*						
Number of primary branches/plant	**-0.534**** -0.690**	**0.454**** 0.566**					
Capsule Length	**0.014** -0.012	**0.164** 0.150	**0.276** 0.308				
Number of capsules/ Plant	**-0.288** 0.437**	**0.313** 0.389*	**0.376*** 0.432**	**0.465**** 0.581**			
Number of seeds/ capsule	**0.103** 0.127	**0.286** 0.296	**0.096** 0.146	**0.480**** 0.627**	**0.581**** 0.842**		
1000-Seed weight	**-0.018** -0.075	**0.393*** 0.406*	**0.248** 0.344*	**0.563**** 0.746**	**0.839**** 0.827**	**0.726*** 0.965**	

** and * indicates significance level at 5% and 1% respectively

The difference in magnitude of the association between characters at phenotypic and genotypic levels indicated that environmental factors play a crucial role in expression of the concerned character. Yield/plant was positively association with number of capsules/plant, number of seeds/capsule, 1000-seed weight, capsule length and plant height where as it had no significant negative association with any trait. The highest significant positive correlation was observed between 1000-seed weight and number of capsules/plant followed by 1000-seed weight with number of seeds/capsule. Significant negative association was observed between days to 50% flowering and number of branches/plant. Similar results were also reported by Iqbal *et al.* (2016); Abhijatha *et al.* (2017); Singh *et al.* (2018); Patil *et al.* (2018); Teklu *et al.* (2019); Takele *et al.* (2021) in sesame.

B. Path coefficient analysis

Path analysis splits the total correlation coefficient into of direct and indirect effects of a set of independent variables on the dependent variable using standardized partial regression coefficient. If the correlation between yield (dependent variable) and other component character (independent variable) is due to the direct effects of character, it indicates the true relationship between them. Selection can be effectively done for such a character in subsequent generations to improve yield. But if the correlation is due to the indirect effect of the character through another component trait, the breeder has to give more emphasis on selection for the later trait through which in direct effect is exerted on yield. The direct and indirect effects were calculated at both phenotypic and genotypic level.

In the present experiment of path coefficient analysis (Table 2) low residual effect of 0.004 indicating that most of the major yield components were included in this study. Highest direct effect (0.558, 0.479) on yield was observed by number of capsules/plant followed by number of seeds/capsule (0.253, 0.331), thousand seed weight (0.250, 0.144), capsule length (0.043, 0.098) both phenotypically and genotypically.

Negative direct effect on seed yield was observed for days to 50% flowering (-0.065,-0.134) and number of branches/plant (-0.042,-0.062). Days to 50% flowering had negative indirect effect via plant height (-0.005,-0.009), number of capsules/plant (-0.155, -0.204) and thousand seed weight (-0.001, -0.009). Plant height showed highest indirect effect via number of capsules/plant (0.174, 0.181). From both phenotypic and genotypic path analysis it was revealed that number of primary branches/plant also exhibited highest indirect effect towards yield via number of capsules/plant (0.204, 0.206). Capsule length had highest indirect effect towards yield via number of capsules/plant (0.254, 0.278) followed by number of seeds/capsule (0.121, 0.204) and 1000-seed weight (0.140, 0.107). Number of capsules/plant has highest indirect effect via number of seeds/capsule (0.146, 0.278) followed by thousand seed weight (0.210, 0.119) towards seed yield/plant respectively both phenotypically and genotypically. Number of seeds/capsule had highest indirect effect via number of capsules/plant (0.324, 0.403) followed by thousand seed weight (0.181, 0.139) towards seed yield/plant. Thousand seed weight had highest indirect effect via number of capsules/plant (0.468, 0.396) followed by number of seeds/capsule (0.183, 0.319) towards seed yield/plant.

In the present study, from both phenotypic and genotypic path analysis it was evident that the highest direct positive effect on yield was observed by number of capsules/plant followed by number of seeds/capsule and1000-seed weight. The highest positive indirect effect was observed by 1000-seed weight via number of capsules/plant followed by number of seeds/capsule via capsules/plant on seed yield. The partial similar results were also observed by Singh *et al.* (2018); Teklu *et al*. (2019); Takele *et al.* (2021). Other characters having a direct positive effect on yield were plant height and capsule length. Days to 50% flowering and number of branches/plant had negative direct effect on seed yield.

Table 2: Phenotypic (bold) and genotypic path coefficient analysis for yield and yield related traits in Sesame.

Characters	Days to 50% flowering	Plant height	Number of primary branches/plant	Capsule Length	Number of capsules /plant	Number of seeds /capsule	1000-Seed Weight
Days to 50% flowering	**-0.065** -0.134	**-0.005** -0.009	**0.022** 0.042	**0.0006** -0.001	**-0.155** -0.204	**0.025** 0.036	**-0.001** -0.009
Plant height	**0.019** 0.052	**0.020** 0.023	**-0.019** -0.034	**0.007** 0.014	**0.174** 0.181	**0.069** 0.094	**0.098** 0.057
Number of branches /plant	**0.034** 0.092	**0.009** 0.013	**-0.042** -0.062	**0.011** 0.029	**0.204** 0.206	**0.021** 0.045	**0.062** 0.049
Capsule Length	**-0.009** 0.001	**0.003** 0.003	**-0.011** -0.018	**0.043** 0.098	**0.254** 0.278	**0.121** 0.204	**0.140** 0.107
Number of capsules/plant	**0.018** 0.057	**0.006** 0.008	**-0.015** -0.026	**0.019** 0.057	**0.558** 0.479	**0.146** 0.278	**0.210** 0.119
Number of seeds/capsule	**-0.006** -0.015	**0.005** 0.006	**-0.003** -0.008	**0.020** 0.061	**0.324** 0.403	**0.253** 0.331	**0.181** 0.139
1000-Seed weight	**0.0005** 0.008	**0.008** 0.009	**-0.010** -0.021	**0.024** 0.073	**0.468** 0.396	**0.183** 0.319	**0.250** 0.144

CONCLUSION

Number of capsules/plant is the most important trait which has positive significant association with seed yield/ plant as well as highest direct effect for seed yield/plant. The other yield attributing traits like number of seeds/capsule and 1000-seed weight also have positive significant association with yield as well as considerably high positive direct effect towards seed yield / plant. Hence selection for these yield component traits will definitely help in improving the seed yield/plant.

FUTURE SCOPE

The present research provides scope for future prospects of breeding with a new approach towards effective selection. Variability study in addition to association and path analysis in the studied genotypes will definitely pave the way towards development of high yielding genotypes through a better crop improvement programme.

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Conflict of Interest. None.

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