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The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(12): 1341-1344

www.thepharmajournal.com
Received: 01-09-2023
Accepted: 04-10-2023

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Analysis of direct and indirect effect of yield contributing traits in sesame (*Sesamum indicum* L.)

SB Mitkari, MP Wankhade, SB Ghuge, KV Kadam and SS Deshmukh

Abstract
The current study was conducted in the summer of 2022–2023 at the Experimental Farm of AICRP on Safflower, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani (Maharashtra), to examine the direct and indirect effects of yield contributing features in 30 genotypes of sesame. Three replications of a randomized block design were used to conduct the current experiment. The trait capsule length had the greatest significant and positive direct effect on seed yield per plant, according to this path analysis of 30 genotypes studied in sesame. At the genotypic level, this was followed by 1000 seed weight, the number of seeds per capsule, plant height, the number of capsules per plant, and the number of branches per plant. The trait 1000 seed weight had the most positive direct effect on seed yield per plant at the phenotypic level, according to the results of path analysis in 30 genotypes of sesame. This was followed by the number of seeds per capsule, plant height, capsule length, and number of capsules per plant.

Keywords: Path analysis, direct effect, indirect effect, sesame, significant

Introduction
From roughly 40° N latitude, one of the most significant oil seed crops in mild, temperate, and tropical countries is sesame (*Sesamum indicum* L.). Although cross-pollination can range from 5 to over 50%, it typically self-pollinates (Pathirana, 1994) [6]. It is a member of the Tubiflorae (Pedaliaceae) order of family. One of the most popular nicknames for it is "queen of oil crop." It is grown in more than 50 countries across the globe. Despite the crop's African origins, India is thought to be the primary hub of genetic variation (Maiti *et al.*, 2012) [3]. Common names for sesame include gingelly, til, and tila. Because to its high oil content (38%–54%), protein (18%–25%), calcium, phosphorus, oxalic acid, and superior seed oil characteristics, sesame is known as the “Queen of oilseeds”. Because lignans (sesamin, sesaminol, and sesamolinol) have a remarkable antioxidant effect and can withstand oxidation, sesame seed oil has a long shelf life. Sesame is the fifth-most popular spice and edible oil. It is also utilized in pharmaceutical and skin care products and acts as a synergistic pesticide. Cattle are given residual oil extraction residues as a source of crude protein. You can eat the grains as sweetmeats, fried, or sweetened. High-quality edible oil or an oily paste (tahini) are made from crushed seeds.

Materials and Methods
In the summer of 2022–2023, the experiment was carried out on the AICRP experimental farm on safflower in Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani (Maharashtra). Thirty sesame germplasm collections made up the study's material. Three replications of the experimental material were assessed using Randomized Block Design (RBD). For the purpose of documenting observations, five plants were randomly chosen from each genotype in each replication. The average value of every characteristic was calculated using the measurements made on certain plants. The following characteristics were noted: days until fifty percent of the plants flowered, plant height (cm), number of main branches per plant, number of capsules per plant, length of capsules (cm), number of seeds per capsule, 1000 seed weight (g), days till maturity, and number of seeds produced per plant (g). Using the path coefficient methodology described by Wright (1921) [8] and Dewey and Lu (1959) [1], the genotypic correlation coefficient between seed yield and its properties was divided into direct and indirect impacts.

Results and Discussion
A complicated characteristic, yield is made up of many different elements, some of which directly and some of which indirectly affect yield. Path analysis is crucial to understanding the

direct and indirect effects of independent variables on yield because correlation analysis only tells us how much yield is associated with its component traits, not the direct and indirect contributions of different independent variables. The dependability of indirect selections used to increase seed production per plant can be inferred from the direct impact of any component attribute on seed yield per plant. Correlation explains the underlying link and selection for the character will be effective if both correlation and direct impacts were high and positive. Tables 1 and 2, respectively, show the path matrix of the 30 genotypes that are the subject of the investigation at the genotypic and phenotypic levels. Whereas, Figures 1 and 2 provide the corresponding path diagrams.

The study examined 30 genotypes of sesame. The maximum positive indirect effect was observed at the genotypic level, where days to 50% flowering was determined by days to maturity. At the phenotypic level, the maximum positive indirect effect was determined by plant height, number of seeds per capsule, capsule length, number of capsules per plant, number of branches, and 1000 seed weight. Days to maturity were found to have the greatest positive indirect effect at the genotypic level through capsule length, plant height, number of seeds per capsule, 1000 seed weight, number of capsules per plant, and number of branches per plant; at the phenotypic level, days to maturity were found to have the greatest positive indirect effect through days to 50% flowering.

The greatest positive indirect effect that plant height had on seed yield per plant at the genotypic level was seen in the days to 50% flowering and days to maturity; at the phenotypic level, the greatest positive indirect effect was seen in the 1000 seed weight, number of seeds per capsule, number of branches per plant, length of capsule, and number of capsules per plant. At the genotypic level, days to maturity, days to 50% flowering, and the number of branches per plant had the greatest positive indirect effect on seed yield per plant. At the phenotypic level, days to maturity and days to 50% flowering had the greatest positive indirect effect.

At the genotypic level, 1000 seed weight had the greatest positive indirect effect through seed yield per plant, number of seeds per capsule, plant height, capsule length, number of capsules per plant, and number of branches per plant; at the phenotypic level, 1000 seed weight had the greatest positive indirect effect through seed yield per plant, number of seeds per capsule, plant height, capsule length, number of capsules per plant, and number of branches per plant. In the thirty sesame genotypes that were the subject of the study, the number of primary branches per plant, plant height, number of seeds per capsule, and 1000 seed weight exerted the maximum positive indirect effect at the genotypic level, while the number of seeds per capsule, length of the capsule, and 1000 seed weight exerted the maximum positive indirect effect at the phenotypic level.

The number of seeds per capsule per plant had the greatest positive indirect effect on seed yield per plant at the genotypic level through seed yield per plant, days to maturity, and days to 50% flowering; at the phenotypic level, the maximum positive indirect effect was mediated by plant height, 1000 seed weight, number of capsules per plant, number of branches per plant, and number of seeds per plant. In the thirty sesame genotypes that were the subject of the study, the number of capsules per plant, plant height, 1000 seed weight, and capsule length all had the greatest positive indirect effects on seed yield per plant at the genotypic level. Similarly, at the phenotypic level, the maximum positive indirect effect was mediated by the number of seeds per capsule, plant height, and 1000 seed weight.

The findings of the path analysis conducted on 30 genotypes of sesame showed that, at the genotypic level, the trait capsule length (1.5913) had the greatest significant and positive direct effect on the number of seeds produced per plant, followed by the 1000 seed weight (0.9020), the number of seeds per capsule (0.7489), the plant height (0.4963), the number of capsules per plant (0.2838), and the number of branches per plant (0.1892). Conversely, at the genotypic level, had the greatest significant and adverse direct impact on the number of seeds produced per plant by days to maturity (-0.2222). Manjeet *et al*. (2019) [4] achieved comparable results.

At the phenotypic level, path analysis results across 30 genotypes of sesame have demonstrated that the trait with the highest positive direct effect on seed yield per plant, at the 1000 seed weight level (0.6665), is followed by the number of seeds per capsule (0.5000), plant height (0.4495), capsule length (0.3119), and number of capsules per plant (0.2838). Vivek *et al.* (2022) [7], Nisha B. Patel *et al.* (2023) [5], and Thefukolie Kehie *et al*. (2020) [2] all obtained similar results.

Table 1: Direct and indirect effects genotypic level of yield components on seed yield in Sesame

Characters	Days to 50% flowering	Days to maturity	Plant height	Capsule length	1000 Seed weight	No of Branches	No of seeds/capsule	No. of Capsule/plant	Seed yield/plant
Days to 50% flowering	0.0150	0.0125	-0.0041	-0.0183	-0.0021	-0.0019	-0.0046	-0.0027	-0.0915
Days to maturity	-0.0367	-0.0442	0.0195	-0.0569	0.0120	0.0068	0.0153	0.0101	-0.2222*
Plant height	0.0283	0.0454	-0.1029	-0.1327	-0.0616	-0.0450	-0.0578	-0.0268	0.4963**
Capsule length	0.0500	0.0529	-0.0531	-0.0412	-0.0706	0.0004	-0.0642	-0.0190	1.5913
1000 Seed weight	-0.1484	-0.2868	0.6300	1.8040	1.0520	0.1926	0.8814	0.2909	0.9020**
No of Branches	-0.0080	-0.0095	0.0273	-0.0006	0.0114	0.0623	0.0123	-0.0095	0.1892
No of seeds/capsule	0.0222	0.0251	-0.0406	-0.1125	-0.0605	-0.0142	-0.0722	-0.0362	0.7489**
No. of Capsule/plant	-0.0140	-0.0176	0.0201	0.0357	0.0213	-0.0117	0.0387	0.0772	0.2838**

R^2 = 0.82, Residual Effect = 0.4237

*Significant at 5 per cent level, **Significant at 1 per cent level

Table 2: Direct and indirect effects phenotypic level of yield components on seed yield in Sesame

Characters	Days to 50% flowering	Days to maturity	Plant height	Capsule length	1000 Seed weight	No. of branches	No. of seeds/capsule	No. of capsule/plant	Seed yield/plant
Days to 50% flowering	-0.0430	-0.0324	0.0109	0.0091	0.0018	0.0048	0.0094	0.0064	-0.0987
Days to maturity	0.0418	0.0556	-0.0229	-0.0142	-0.0121	-0.0061	-0.0143	-0.0108	-0.1950
Plant height	-0.0319	-0.0521	0.1262	0.0374	0.0607	0.0484	0.0528	0.0247	0.4495**
Capsule length	0.0067	0.0082	-0.0095	-0.0320	-0.0136	-0.0026	-0.0126	-0.0082	0.3119**
1000 Seed weight	-0.0226	-0.1150	0.2540	0.2248	0.5284	0.0676	0.2681	0.0937	0.6665**
No. of branches	-0.0015	-0.0015	0.0053	0.0011	0.0018	0.0138	0.0018	-0.0016	0.1400
No. of seeds/capsule	-0.0377	-0.0441	0.0719	0.0677	0.0871	0.0223	0.1717	0.0565	0.5000**
No. of capsule/plant	-0.0104	-0.0135	0.0137	0.0179	0.0124	-0.0082	0.0230	0.0699	0.2307*

R^2 = 0.48, Residual Effect = 0.7097

*Significant at 5 percent level, **Significant at 1 per cent level

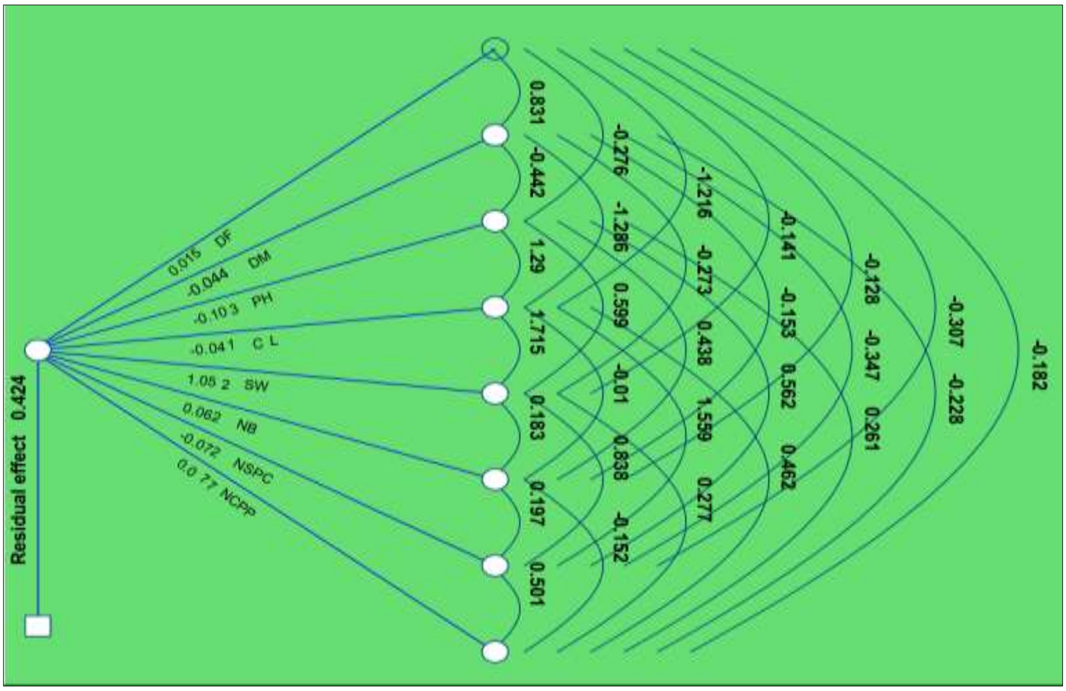

Fig 1: Genotypic path diagram for nine characters in sesame

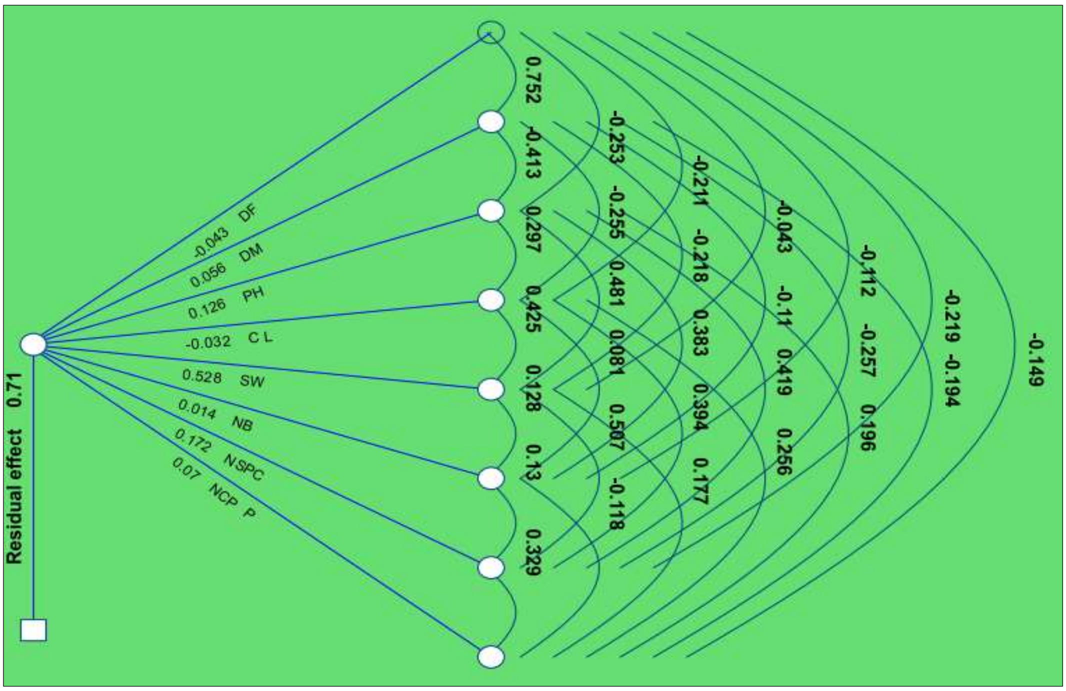

Fig 2: Phenotypic path diagram for nine characters in sesame

Conclusion

The largest significant and positive direct effect on seed yield per plant was exerted by the trait capsule length, which was followed at the genotypic level by 1000 seed weight, number of seeds per capsule, plant height, number of capsules per plant, and number of branches per plant. The trait 1000 seed weight had the most positive direct effect on seed yield per plant at the phenotypic level, according to the results of path analysis in 30 genotypes of sesame. This was followed by the number of seeds per capsule, plant height, capsule length, and number of capsules per plant.

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