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Original Research Article

Path analysis studies in Safflower germplasm (*Carthamus tinctorius* L.)

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A B S T R A C T

The present experiment has been carried out to study path analysis studies in safflower (*Carthamus tinctorius* L.). The experimental materials consists of 150 safflower germplasm including 5 checks were evaluated in augmented randomized block design with 5 blocks during *rabi* 2012–2013 at experimental farm of All India Coordinated Research Project on Safflower, V.N.M.K.V., Parbhani. The data were recorded on five competitive fertile plants for days to 50% flowering, days to maturity, plant height (cm), number of branches per plant, number of secondary branches, number of effective capitula per plant, number of seeds per capitulum, number of spines, test weight (gm), hull content(%),oil percent, flower colour, seed yield per plant (gm). Path analysis revealed that the character number of effective capitula per plant, days to maturity, 100 seed weight and number of spines had strong positive association with seed yield indicating importance of direct selection for these characters.

Keywords

Seed yield, Path analysis, Safflower, Germplasm

Introduction

Seed yield is a complex trait conditioned by the interaction of various growth and physiological processes throughout the life cycle. The appropriate knowledge of such interrelationship between seed yield and its contributing characters can significantly improve the efficiency of breeding programme. The nature of association between seed yield and its components determine the appropriate trait to be used in indirect selection for improvement in the seed yield. Path coefficient analysis permits the separation of each character to the yield could be estimated.

It is used in the plant breeding programme to determine the nature of relationship between yield and yield components that are useful as selection criteria to improve the crop yield. The goal of path analysis is to estimate the importance of the affecting of several traits on specific trait. Direct effects tell how a one unit change in A will affect B, holding all other variables constant. However, it may be that other variables are not likely to remain constant if A changes. e.g. a change in A can produce a change in C which in turn produce a change in B.

Selection for component trait with a view to improve a yield is called as indirect selection, while selection for yield per se is called as direct selection.

Material and Methods

The present field study was undertaken at All India Co-ordinated Research Project on safflower, during *Rabi* season 2012–13 under irrigated conditions, at Department of Agricultural Botany, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani (Maharashtra). The campus is being geographically situated in Deccan plateau, not semiarid eco region in Maharashtra state at 19^0 16' N latitude and 76^0 54' E longitude with an altitude of 409 meter above mean sea level.

The experimental material for present study comprised of one hundred fifty germplasm accessions (entries) along with five check viz, Bhima, Manjira, JSF-1, Annegiri-1 and HUS-305. The Augmented Randomized Block Design was used with single replication and the plant spacing within a row was 20 cm and row to row spacing was 45 cm. The plot size was single row of 1m length (total 35 rows per block) and numbers of plots/block were five.

Recommended package of practices were followed to raise the good crop. The data were recorded on five competitive fertile plants for days to 50% flowering, days to maturity, plant height (cm), number of branches per plant, number of secondary branches, number of effectives capitula per plant, number of seeds per capitulum, number of spines, test weight (gm), hull content (%), oil percent, flower colour, seed yield per plant (gm).

The direct and indirect effects at genotypic level for genotypes were estimated by taking seed yield as dependent variable using, path analysis as suggested by Dewey and Lu (1959). The characters in addition to the seed yield per plant were selected for path analysis and all possible simple correlation coefficient were worked out.

The concept behind path analysis is that, the yield is function of various components like X_1, X_2, X_3, X_4, etc. A path diagram is constructed using simple correlation coefficients among various characters under study. It helps in setting up simultaneous equations, which are used for the estimation of direct effects.

From the figure, it is obvious that yield is the result of X_1, X_2 and X_3 and some other undefined factors which are designated by R (Residual effect). The double arrowed lines indicate mutual association as measured by correlation coefficient ($r_{1.2}$, $r_{1.3}$ and $r_{2.3}$) and the single arrowed lines represents direct influence as measured by path coefficient (P_{ij}).

The direct path coefficient was obtained by solving a set of 'p' simultaneous equation by the abbreviated poolittle technique.

$r_{01} = P_{01} + P_{02} + r_{12} + \ldots\ldots\ldots\ldots P_{op}r_{1p}$
$r_{02} = P_{01} + r_{12} + P_{02} + \ldots\ldots\ldots\ldots P_{op}r_{2p}$
$r_{op} = P_{01}r_{1p} + P_{02}r_{2p} + \ldots\ldots\ldots\ldots P_{op}$

Where,

1. P_{01}, P_{02} ……. P_{op} are the path effect of 1,2 ……. p variables (independent), on 'o' variable (dependent).
2. r_{12}, r_{13} ……. r_{1p} …….. r_p (p-1) are the possible correlation coefficient between various independent variables.
3. r_{01}, r_{02} …… r_{op} are the correlation coefficient of

independent variables with dependent variables.

The indirect effect of a particular character through other character was obtained by multiplication of direct path effect and particular characters, respectively.
The indirect effect of i^{th} independent variable and j^{th} independent variable on dependent variables was worked out as,
Indirect effect = $r_{ij} * p_{oj}$

Where,

i = 1 to p-1
j = 1 to p
r_{ij} = correlation coefficient between i^{th} and j^{th} variables (independent)
p_{oj} = direct path effect of i^{th} independent variables on dependent variable

From the simultaneous equation; it is clear that correlation coefficient is the sum of direct and indirect path coefficient.

Calculation of residual effect (R)

The residual effect permits precise explanation about the pattern of interaction of other possible components of yield. In other words, residual effect measures the role of other independent variables which were not included in the study on the dependent variable.

Results and Discussion

Path coefficient analysis

Path coefficient analysis is an effective tool to analyse the direct and indirect influence of different characters on yield. This helps in giving due weightage to a particular character during selection.

The path analysis (Table 1) indicated that the character number of effective capitula per plant exerted the highest direct positive effect (0.413) on seed yield per plant followed by days to maturity (0.353) and number of secondary branches per plant (0.096).

Jawanjal (2006) reported that the maximum direct effect on seed yield was shown by number of secondary branches per plant followed by days to maturity, number of primary branches, plant height and 100 seed weight. Present findings are also in conformity with those of Diwakar *et al*. (2006) and Shivani *et al*. (2010). The direct negative influence were observed for days to 50 per cent flowering (-0.279), plant height (-0.031), number of primary branches (-0.02) and hull content (-0.07). These findings are in conformity with Jawanjal (2006).

The present investigation clearly revealed that the character number of effective capitula per plant, days to maturity, numbers of spines, 100 seed weight, number of capitulum showed higher direct positive effects and indirect effects via other components traits.

These indicated that direct selection for these characters will enhance the breeding efficiency for seed yield in safflower. Hence, for a plant breeder engaged in the improvement of safflower yield, it would be necessary to lay the maximum emphasis on above mentioned characters. The residual factor (0.81) explain that some other factors which have not been considered needs to included in this analysis to account fully for variation in yield.

Table.1 Direct (diagonal) and indirect effects of different characters on seed yield in safflower

Sr.No	Characters	Days to 50% flowering	Days to Maturity	Final plant height (cm)	No.of pri. Bracnches	No.of Sec branches	No. of effective capitula /plant	No.of seeds/capitulum	Spines of OIB on main capitula	Hull content (%)	100 seed weight (gm)	Oil content (%)	Correlation withSeed yield/plant (gm)
1	**Days tp 50% flowering**	**-2.279**	0.325	-0.005	0.00	0.01	-0.02	0.003	0.01	-0.003	-0.004	-0.001	0.036
2	**Days to maturity**	-0.257	**0.353**	-0.007	0.00	0.015	-0.011	0.003	0.014	0.00	0.009	0.004	0.124
3	**Final Plant height (cm)**	-0.046	0.082	**-0.031**	-0.004	0.016	-0.008	0.002	0.02	0.00	0.002	0.009	0.043
4	**No.of pri branches**	-0.002	-0.007	-0.006	**-0.02**	0.059	0.162	0.001	0.008	0.001	0.006	0.002	0.204*
5	**No. of sec branches**	-0.028	0.054	-0.005	-0.012	**0.096**	0.189	0.005	0.013	0.003	0.008	0.001	0.324**
6	**No.of effective capitula/plant**	0.013	-0.009	0.001	-0.008	0.044	**0.413**	0.004	0.012	-0.004	0.039	-0.003	0.502**
7	**No.of seeds/ capitulum**	-0.023	0.038	-0.002	-0.001	0.015	0.05	**0.031**	0.008	0.007	0.012	-0.004	0.132
8	**Spines of OIB on main capitula**	-0.021	0.036	-0.004	-0.001	0.009	0.035	0.002	**0.138**	-0.015	0.00	-0.002	0.177*
9	**Hull content (%)**	-0.012	-0.002	0.00	0.00	-0.004	0.025	-0.003	0.029	**-0.07**	0.001	-0.002	-0.038
10	**100 seed weight (gm)**	0.012	0.032	-0.001	-0.001	0.007	0.156	0.004	0.001	-0.001	**0.103**	0.003	0.315**
11	**Oil content(%)**	0.005	0.02	-0.004	-0.001	0.002	-0.019	-0.002	-0.004	0.002	0.004	**0.067**	0.07

Residual effect = 0.815

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