

Correlation and Path Coefficient Analysis of quantitative traits in Linseed (*Linum usitatissimum* L.)

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Abstract

The present study has been conducted to determine correlation and path coefficient analysis among 40 linseed genotypes using ten traits for yield and yield component. It was carried out at experimental farm department of Genetics and Plant Breeding field at College of Agriculture, Latur (Maharashtra) during Rabi 2024-25 which were sown in RBD Design at 30 cm x 5 cm spacing. Genotypic and phenotypic correlation analyses revealed highly significant positive associations for seed yield with traits such as number of branches plant, number of capsules plant, number of seeds per capsule, 1000 seed weight (g), harvest index (%) and oil content (%). Path coefficient analysis further established that no. of branches per plant, 1000 seed weight (g), harvest index (%) and oil content (%) exerted the highest direct positive effects on seed yield. Path coefficient analysis is revealed that direct and indirect effects of genotypic path coefficients were higher in magnitude than the corresponding phenotypic path coefficients.

Keywords: Linseed, Correlation analysis, Path coefficient analysis, Genetics

Introduction

Linseed (*Linum usitatissimum* L.) has a chromosome number of $2n=30$ and is one of the most important Rabi oilseed crops belonging to the genus *Linum*. It is an annual, self-pollinated and non-edible oil crop, commonly known as “Alsi.” Currently linseed is widely cultivated across Asia, Europe, America and Africa for both oil and fiber production. The primary use of linseed seeds is for oil extraction, which serves various industrial purposes. Every part of the linseed plant is commercially utilized either directly or after processing. Approximately 80% of linseed oil production is used in industries such as paint, varnishes, printing ink, pad ink, soaps, patent leather, and the manufacture of linoleum and oilcloth. The remaining 20% of linseed oil is used for edible purposes. According to Vavilov, linseed has two centers of origin the oil type originated in Southwest Asia, while the fiber-type originated in the Mediterranean region. It has been found that the daily consumption of 25 g of linseed reduces the risk of breast cancer. For the normal growth and development of linseed, cool climatic conditions are considered most suitable. The minimum and maximum temperature requirements for its optimal growth are 10°C and 38°C respectively, the ideal

sowing period is from October to November. Linseed is cultivated in most of the countries across the world.

As per the latest data from 2024-25, the global production of linseed stands at approximately 3.068 million tonnes from 3.223 million hectares, with an average productivity of 952 kg/ha. Russia leads in linseed production globally, followed by Kazakhstan and Canada. In India, linseed production is estimated at around 100,000 tonnes from 170,000 hectares, with an average productivity of just 574 kg/ha, which is significantly below the global average. Within India, major linseed-growing states include Madhya Pradesh, Uttar Pradesh, Chhattisgarh, Bihar, Jharkhand, and Maharashtra. Maharashtra, in particular, shows notably low productivity, with average yields recorded around 267 kg/ha mainly due to limited genetic improvement, lack of awareness, and poor agronomic practices.

The correlation and path coefficient analysis enable us to understand the related importance of different yield component traits. So that an appropriate selection strategy is formulated. The correlation between various morphological characters and yield contributing traits with yield provides insights into growth and yield attributes. Correlation which represents the relationship between variables assists researchers in identifying the most effective methods for genotype selection. A path coefficient is a standardized partial regression coefficient that partitions a correlation coefficient into its direct and indirect effects based on predefined cause-and-effect relationships. The present study was undertaken to determine the correlation and path coefficients among yield and its component traits in Linseed genotypes. The objective was to identify the key traits that can serve as reliable selection indices for enhancing grain yield in future breeding programs.

Materials and Methods

The experiment was conducted using 40 genotypes of Linseed laid out in a randomized block design (RBD) with two replications during the rabi season (2024-25) at experimental farm department of Genetics and Plant Breeding field at College of Agriculture, Latur (Maharashtra) Each genotype was sown in a plot measuring $5 \times 0.12 \text{ m}^2$ with a row-to-row spacing of 30 cm and plant-to-plant spacing of 5 cm. Standard agronomic practices were followed throughout the cropping season to ensure uniform crop management and appropriate plant protection measures were undertaken when necessary. Data were recorded for ten quantitative traits such as days to 50% flowering, days to maturity, plant height, number of branches per plant, number of capsules per plant, number of seeds per capsules, 1000 seed weight (g), harvest index (%), oil content (%) and seed yield per plant. The correlation coefficients were calculated to determine the degree of association of various characters with yield and also among the yield components. Fisher (1918) formula was used to calculate the correlation. The direct and indirect effects were estimated using path coefficient analysis, which was proposed by Wright (1921).

Result and Discussion

Correlation Analysis

The genotypic and phenotypic correlation coefficients among ten quantitative traits of 40 linseed genotypes were estimated in (Table 1 & Table 2). Genotypic correlations were generally higher in magnitude than the corresponding phenotypic correlations, indicating a stronger genetic contribution to trait associations. Seed yield per plant showed a significant positive correlation with harvest index at both genotypic (0.4822**) and phenotypic (0.4365*) levels, indicating its importance in yield improvement. A

positive but relatively weak association of seed yield was observed with 1000-seed weight, number of capsules per plant, number of seeds per capsule and oil content. Days to 50% flowering, days to maturity, plant height and number of branches per plant showed negative associations with seed yield.

A significant positive association was observed between number of branches and capsules per plant at the genotypic level (0.2208*). Number of seeds per capsule exhibited a significant negative correlation with 1000-seed weight at both genotypic (-0.6344**) and phenotypic (-0.2802*) levels, suggesting a trade-off between seed number and seed size. Oil content showed positive associations with seed yield at both levels. Overall, the results indicated that harvest index was an important selection criterion for improving seed yield, while other positively associated yield components could be considered in simultaneous selection. Similar findings were reported by Rajanna et al. (2014), Paul et al. (2015), Ibrar et al. (2016) and Tadesse et al. (2009).

Path Analysis

Path coefficient analysis was performed to partition the correlations between yield-contributing traits and seed yield per plant into direct and indirect effects in linseed (Table 3 & 4). At the genotypic level, harvest index had a positive direct effect (0.4094**) and a strong positive correlation with seed yield (0.4822**), indicating that its association with yield was largely consistent with its direct contribution. The largest positive direct effect was observed for 1000-seed weight (0.5030**), followed by number of seeds per capsule (0.3950**) and number of capsules per plant (0.3114**), highlighting their potential importance in determining seed yield. However, the genotypic correlations of number of capsules per plant and number of seeds per capsule with yield were relatively low (0.1285**) and (0.0690**), suggesting that indirect effects or opposing associations with other traits moderated their overall relationships with yield. Oil content showed a positive direct effect (0.1138**) and a weak positive correlation with seed yield (0.0653**), indicating a favourable, although limited, association and the potential for simultaneous improvement of yield and oil content. In contrast, days to 50% flowering had a negative direct effect (-0.3110) and a negative correlation with seed yield (-0.2113), suggesting that later flowering was generally associated with lower yield. Days to maturity also showed a negative overall association with yield (-0.1688), whereas plant height had a negligible negative association (-0.0057) and number of branches per plant had a weak positive association (0.0316*). At the phenotypic level, harvest index again showed the largest positive direct effect (0.4087**) and a strong positive correlation with seed yield (0.4365*), confirming its consistent importance across both levels of analysis.

Overall, the consistency of the positive effects of harvest index, 1000-seed weight, number of capsules per plant, number of seeds per capsule and oil content across the genotypic and phenotypic analyses identifies these traits as promising selection criteria for improving seed yield in linseed.

Conclusion

Correlation analysis revealed that genotypic correlation coefficients were generally higher than the corresponding phenotypic correlations, indicating a stronger genetic influence on trait associations. Harvest index exhibited the highest significant positive correlation with seed yield at both genotypic (0.4822**) and phenotypic (0.4365*) levels. Path coefficient analysis further confirmed that harvest index recorded the highest positive direct effect on seed yield at both genotypic (0.4094) and phenotypic (0.4087) levels. 1000-seed weight, number of seeds per capsule and number of capsules per plant also

showed positive direct effects, particularly at the genotypic level. Oil content exhibited positive direct effects at both levels, indicating scope for simultaneous improvement of seed yield and oil content. Days to 50% flowering showed a consistent negative direct effect on seed yield at both genotypic and phenotypic levels. Therefore, harvest index, along with important yield-contributing traits, may be emphasized as selection criteria for improving seed yield in linseed. The combined correlation and path analysis provides useful information for formulating effective selection strategies in linseed breeding programmes.

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